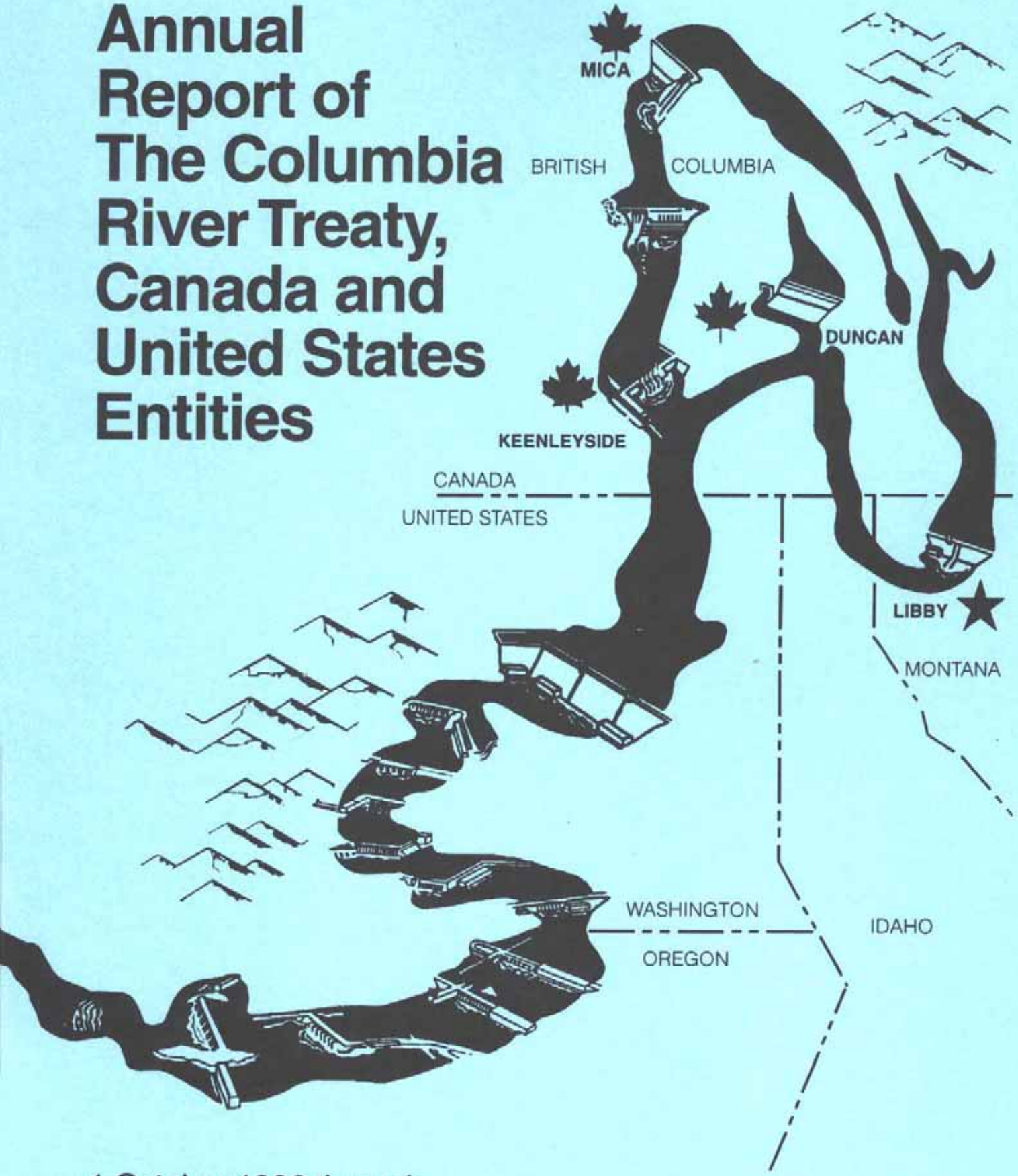
Annual Report of The Columbia River Treaty, Canada and United States Entities



1 October 1996 through
30 September 1997

November 1997

ANNUAL REPORT OF
THE COLUMBIA RIVER TREATY
CANADIAN AND UNITED STATES ENTITIES

FOR THE PERIOD

1 OCTOBER 1996 - 30 SEPTEMBER 1997

Executive Summary

Entity Agreements

Agreements approved by the Entities and/or various Public Utility District's (PUD's) during the period of this report include:

- Columbia River Treaty Entity Agreement on the Detailed Operating Plan for Columbia River Storage for 1 August 1997 through 31 July 1998, signed 30 July 1997.
- Columbia River Treaty Entity Agreement on Aspects of the Delivery of the Canadian Entitlement for 1 April 1998 Through 15 September 2024 Between the Canadian Entity and the United States Entity, signed 20 November 1996.
- Canadian Entitlement Allocation Extension Agreement executed by the United States of America acting by and through the Bonneville Power Administrator acting in the capacity of Bonneville Power Administrator and acting for and on behalf of the United States Entity and Public Utility District No. 2 of Grant County, Washington (Priest Rapids Project), dated 29 April 1997.
- Canadian Entitlement Allocation Extension Agreement executed by the United States of America acting by and through the Bonneville Power Administrator acting in the capacity of Bonneville Power Administrator and acting for and on behalf of the United States Entity and Public Utility District No. 2 of Grant County, Washington (Wanapum Project), dated 29 April 1997.
- Canadian Entitlement Allocation Extension Agreement executed by the United States of America acting by and through the Bonneville Power Administrator acting in the capacity of Bonneville Power Administrator and acting for and on behalf of the United States Entity and Public Utility District No. 1 of Douglas County, Washington (Wells Project), dated 29 April 1997.
- Canadian Entitlement Allocation Extension Agreement executed by the United States of America acting by and through the Bonneville Power Administrator acting in the capacity of Bonneville Power Administrator and acting for and on behalf of the United States Entity and Public Utility District No. 1 of Chelan County, Washington (Rock Island Project), dated 29 April 1997.
- Canadian Entitlement Allocation Extension Agreement executed by the United States of America acting by and through the Bonneville Power Administrator acting in the capacity of Bonneville Power Administrator and acting for and on behalf of the United States Entity and Public Utility District No. 1 of Chelan County, Washington (Rocky Reach Project), dated 29 April 1997.

Operating Committee Agreements

Agreements approved by the Operating Committee include:

- Columbia Treaty Operating Committee Agreement on Operation of Treaty Storage for Enhancement of Whitefish Spawning for January 1 through April 30, 1997, signed 16 January 1997.
- Columbia Treaty Operating Committee Agreement on Operation of Treaty Storage for Enhancement of Trout Spawning for March 1 through July 31, 1997, signed 4 April 1997.
- Agreement among the Columbia River Treaty Operating Committee and the Bonneville Power Administration and British Columbia Hydro and Power Authority on the Operation of Canadian Treaty and Libby Storage Reservoirs and Exchanges of Power for the Period 1 August 1997 through 16 January 1998, signed 4 August 1997.
- Columbia River Treaty Operating Committee Agreement On Operation of Treaty Storage for Nonpower Uses For January 1 through July 31, 1998, signed 18 September 1997.

System Operation

The coordinated system filled to 99.46 percent of capacity by 31 July 1996 in the Actual Energy Regulation (AER) study that implements the Pacific Northwest Coordination Agreement (PNCA) operating plan. As a result, first year firm load carrying capability (FLCC) was adopted for the 1996-97 operating year. Actual storage capacity was filled to 97 percent of full. Due to above average streamflows throughout the year, the system generally operated to Operating Rule Curve or Flood Control Curve for the entire period.

The 1 January 1997 water supply forecast for the Columbia River at the Dalles (January-July) was 138.0 million acre-feet (Maf), or 130 percent of the 1961-90 average. January rainfall was above normal and February rainfall was below normal, and the 1 March volume runoff forecast moved upward to 134 percent of normal. Above March rainfall raised the forecast to 141 percent on 1 April. April rainfall was above normal and May rainfall was below normal, and the 1 June volume forecast was 159 Maf or 150 per cent. The actual January-July observed runoff was 159 Maf, or 150 percent of average,

which is the second highest in the 119 years of record. The peak daily average flow observed at The Dalles was 570,700 cubic feet per second (cfs) on 15 June 1997.

The lower Columbia River flow was regulated for juvenile fish between 1 April and 31 August, based on recommendations of the "Technical Management Team" (TMT) consisting of representatives from five U.S. Federal agencies. State fishery agencies and Indian tribes also provided input at the TMT meetings. This information was usually provided through the Fish Passage Center (FPC). The TMT's Executive and Technical groups make recommendations to the two operating agencies (Corps of Engineers and Bureau of Reclamation) on dam and reservoir operations to optimize passage conditions for juvenile and adult anadromous salmons in accordance with the National Marine Fisheries Service's Biological Opinion (BiOp). Each year, the TMT will also prepare a Water Management Plan to meet various fishery, flow, reservoir operation, and other objectives.

Coordinated System storage energy in the AER reached a level of 99.09 percent of full on 31 July 1997. This value was used to determine the Firm Load Carrying Capability (FLCC), with first-year FLCC being adopted for the 1997-98 operating year. The actual reservoir refill was 95.9 percent of full.

From 1 August 1996 through 31 March 1997 generation at downstream projects in the United States, delivered to the Columbia Storage Power Exchange (CSPE) participants under the Canadian Entitlement Exchange Agreement, was approximately 254 average megawatts at rates up to 486 megawatts. From 1 April through 31 July 1997 the delivery was 246 average megawatts, at rates up to 471 megawatts. All CSPE power was used to meet Pacific Northwest loads.

From 1 April 1996 through 31 March 1997, the Canadian Entity delivered 0.9 average megawatts of energy and no dependable capacity to the U.S. Entity under the Canadian Entitlement Purchase Agreement, and between 1 April 1997 and 31 July 1997, the Canadian Entity delivered 2.8 average megawatts of energy and no dependable capacity to the U.S. entity under the CSPE/CEPA.

Treaty Project Operation

The Treaty projects, Duncan, Mica, and Arrow, were operated throughout the year in accordance with the 1996-97 Detailed Operating Plan, the Flood Control Operating Plan, and several Operating Committee agreements on nonpower uses. Throughout the year, Libby reservoir was operated in

accordance with the flood control operating plan, as amended by the U.S. Corps of Engineers (USACE) "Review of Flood Control, Columbia River Basin, Columbia River & Tributaries Study, CRT-63", June 1981. The above were modified by a State of Montana request to limit Libby outflows to powerhouse capacity to alleviate Total Dissolved Gas (TDG) concerns. During a portion of the year, Libby was operated for power requirements according to the PNCA AER, and during the remainder of the operating year Libby operated for storage and releases required for endangered White Sturgeon and Salmon as required by both the U.S. Fish and Wildlife Service and the National Marine Fishery Service Biological Opinions. The Canadian Entity has given notice that it considers the BiOp fishery operation to be inconsistent with the AOP and Columbia River Treaty.

Mica Treaty storage was 6.7 Maf on 31 July 1996, and with continued storing, reached 7.0 Maf or 100 percent full content on 12 August 1996. The actual reservoir elevation reached a high of Elev. 2475.4 feet (0.4 feet above full) on 1 September. By 31 December, Treaty storage was drafted to 4.2 Maf and the observed reservoir level had dropped to Elev. 2427.2 feet. Treaty storage reached the lowest level on 30 April 1997 at 0.1 Maf. The reservoir reached its lowest level for the 1996-97 water year, Elev. 2383.6 feet, on 25 April 1997, 21 feet lower than the previous year. From then on, Mica's Treaty storage refilled, reaching 94 percent of full (3337 thousand second foot days (ksfd) or 6.6 Maf) on 31 July 1997. The maximum level for 1997, Elev. 2474.4 feet, 0.6 feet from full, was reached on 14 August 1997.

The Arrow Treaty storage account started the 1996-97 operating year (1 August 1996) at 7.1 Maf, or 100 percent full, following its 1996 operating year maximum level of Elev. 1442.6 feet on 10 July 1996. The reservoir was drafted to elevation (Elev.) 1418.1 feet on 31 December 1996 with a Treaty storage of 4.9 Maf or 68 percent of full. During January through July, Arrow operated under several Operating Committee Agreement on the operation of Treaty storage for non-power uses. This agreement allowed the operation of Arrow Dam to be coordinated for both Canadian and U.S. fisheries, and recreation and dust storm avoidance benefits in Canada. Arrow reached its lowest level of the year Elev. 1389.5 feet on 31 March 1997. Arrow Treaty storage reached its annual minimum on 31 March at 0.8 Maf or 11 percent full. April through July, Arrow discharges were held between 15 - 20 thousand cubic feet per second (kcfs) to ensure rainbow trout would not spawn at high river levels. This caused Arrow to fill to Elev. 1397.6 feet by 30 April. Between the end of May towards the end of June, Arrow outflow began at 25 kcfs and increased to 47 kcfs, which protected trout eggs. High spring runoff in the

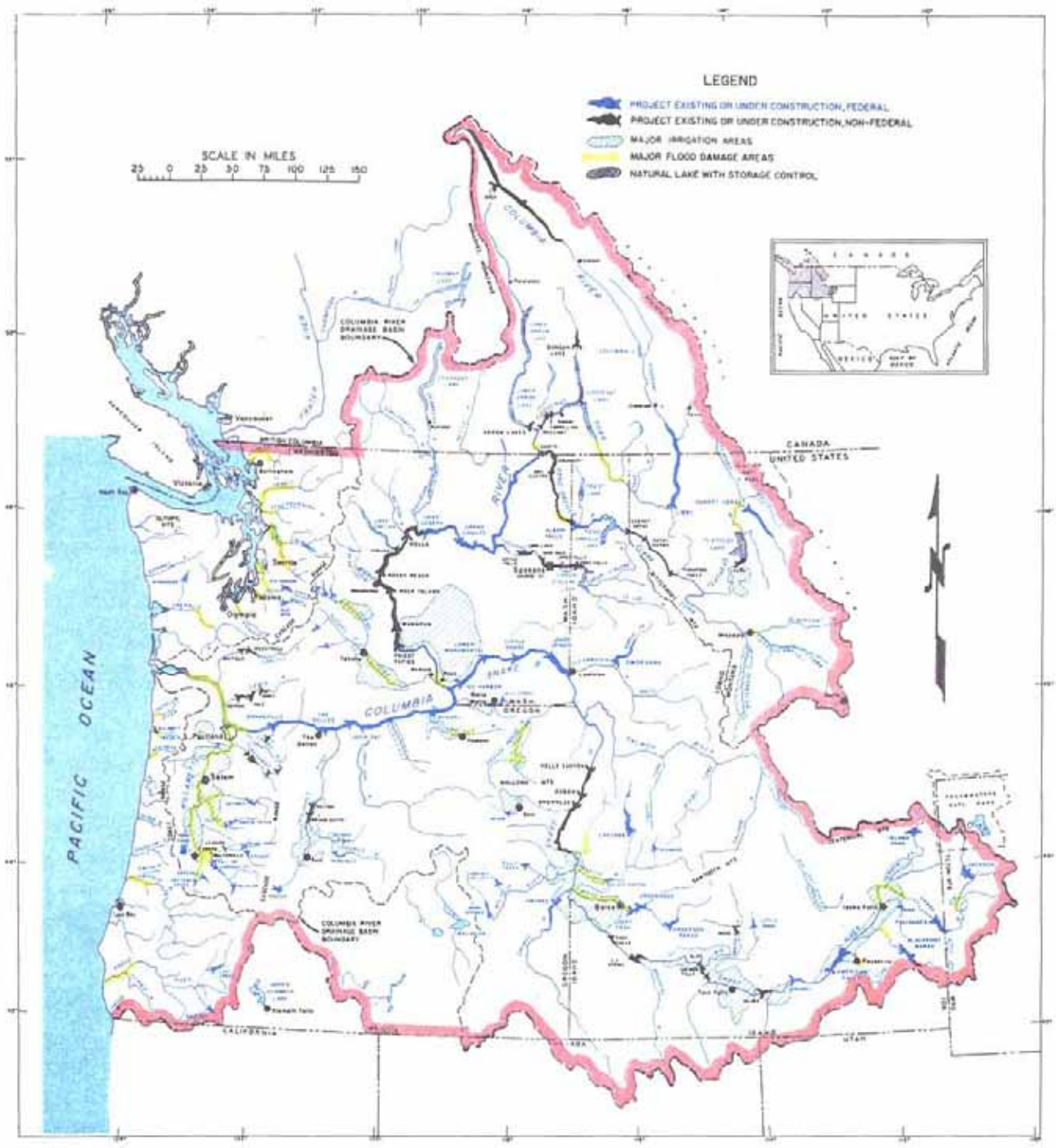
Kootenay River caused a backwater at the Norns Creek fan. The Arrow reservoir filled to Elev. 1437.4 feet by 30 June. During July, Arrow discharge was increased as Treaty storage neared full. The Arrow Reservoir reached its highest level of Elev. 1444.1 feet on 3 July 1997. The Arrow Treaty storage reached 100 percent full on 31 July 1997. During August, increased outflows drafted Arrow to Elev. 1438.98 feet. Further drafting to Elev. 1432.19 feet was done by 30 September 1997 with Arrow Treaty storage at 6.4 Maf or 90 percent of full. To minimize spill at the Kootenay River plants in Canada, the Operating Committee Agreement permitted a Libby-Arrow water transfer agreement in 1997. Under the agreement, Libby volume releases were reduced by a total of 190 ksfd through late July to early August, and an equal amount of water was released from Arrow Reservoir. This water will be returned to Arrow Reservoir in the October to 16 January period.

Duncan reservoir over filled by the end of the 1995-96 operating year with a reservoir level of Elev. 1892.2 feet on 31 July 1996. The project passed inflow for the remainder of August to maintain the reservoir near full pool. During September to December, Duncan was used to support the Kootenay Lake level and by 31 December, Duncan reservoir had drafted to Elev. 1857.4 feet (58 percent of full). Project releases were reduced during part of November and early December to keep Kootenay Lake below the IJC level. Duncan reached its lowest level during the 1996-97 operating year of Elev. 1796.6 feet, on 1 May 1997. Minimum release during May to early July helped refill the reservoir to Elev. 1891.96 feet (0.04 feet below full) by 31 July 1997. With outflows increased to near inflow, the project maintained near full pool. On 1 September, outflow was increased to begin drafting Duncan and filling Kootenay Lake. By 30 September 1997, Duncan had been drafted to Elev. 1889.83 feet.

During the 1995-96 operating year, Libby reached its maximum level of Elev. 2458.96 feet (0.04 feet below full pool) on 31 July 1996. The first 12 days of August saw Libby releasing 24 kcfs and then reducing to 12 - 14 kcfs for the remainder of the month to stem high water difficulties near Bonners Ferry. Libby did not release its full BiOp volume allocation because of high inflows and an agreement to store approximately 200 ksfd of Arrow Treaty water. In return, Arrow delivered the 200 ksfd in August. The project was drafted to 2402.13 feet by the end of December, which is 8.87 feet below the Upper Rule Curve, in anticipation of a large water year and to try to eliminate possible spill to get down to required flood control elevations in 1997. Project releases in the spring considered flood control, sturgeon flows, refill for recreation and salmon flows. Two sturgeon pulses were provided in June at the request of the U.S. Fish and Wildlife Service. Libby reached its maximum level of 2454.82 (4.18 feet from full) on

August 12. The end of August elevation, after the draft for salmon, was 2450.12 feet, less than 10 feet from full.

COLUMBIA RIVER AND COASTAL BASINS



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1997 Report of The Columbia River Treaty Entities
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I Introduction

This annual Columbia River Treaty Entity Report is for the 1997 Water Year, 1 October 1996 through 30 September 1997. It includes information on the operation of Mica, Arrow, Duncan, and Libby reservoirs during that period with additional information covering the reservoir system operating year, 1 August 1996 through 31 July 1997. The power and flood control effects downstream in Canada and the United States are described. This report is the thirty-first of a series of annual reports covering the period since the ratification of the Columbia River Treaty in September 1964.

Duncan, Arrow, and Mica reservoirs in Canada and Libby reservoir in the United States of America were constructed under the provisions of the Columbia River Treaty of January 1961. Treaty storage in Canada is required to be operated for the purposes of flood control and increasing hydroelectric power generation in Canada and the United States of America. In 1964, the Canadian and the United States governments each designated an Entity to formulate and carry out the operating arrangements necessary to implement the Treaty. The Canadian Entity is the British Columbia Hydro and Power Authority (B.C. Hydro). The United States Entity is the Administrator of the Bonneville Power Administration (BPA) and the Division Engineer of the North Pacific Division, Army Corps of Engineers (ACE).

The following is a summary of key features of the Treaty and related documents:

1. Canada is to provide 15.5 million acre-feet (Maf) of usable storage. (This has been accomplished with 7.0 Maf in Mica, 7.1 Maf in Arrow and 1.4 Maf in Duncan.)

2. For the purpose of computing downstream benefits the U.S. hydroelectric facilities in the base system will be operated in a manner that makes the most effective use of the improved streamflow resulting from operation of the Canadian storage.

3. The U.S. and Canada are to share equally the additional power generated in the U.S. resulting from operation of the Canadian storage.

4. The U.S. paid Canada a lump sum of the $64.4 million (U.S.) for expected flood control benefits in the U.S. resulting from operation of the Canadian storage for flood control.

5. The U.S. has the option of requesting the evacuation of additional flood control space above that specified in the Treaty, for a payment of $1.875 million (U.S.) for each of the first four requests for this "on-call" storage.

6. The U.S. constructed Libby Dam with a reservoir that extends 42 miles into Canada and for which Canada made the land available.

7. Both Canada and the United States have the right to make diversions of water for consumptive uses and, in addition, since September 1984 Canada has had the option of making for power purposes specific diversions of the Kootenay River into the headwaters of the Columbia River.

8. Differences arising under the Treaty which cannot be resolved by the two countries may be referred to either the International Joint Commission (IJC) or to arbitration by an appropriate tribunal.

9. The Treaty shall remain in force for at least 60 years from its date of ratification, 16 September 1964.

10. In the Canadian Entitlement Purchase Agreement of 13 August 1964, Canada sold its entitlement to downstream power benefits to the United States for 30-years beginning at Duncan on 1 April 1968, at Arrow on 1 April 1969, and at Mica on 1 April 1973.

11. Canada and the U.S. are each to appoint Entities to implement Treaty provisions and are to jointly appoint a Permanent Engineering Board (PEB) to review and report on operations under the Treaty.

II Treaty Organization

Entities

There was one meeting of the Columbia River Treaty Entities (including the Canadian and U.S. Entities and Entity Coordinators) during the year on the morning of 4 February 1997 in Vancouver, British Columbia. The members of the two Entities at the end of the period of this report were:

UNITED STATES ENTITY
Mr. Randall W. Hardy, Chair
Administrator & Chief Executive Officer
Bonneville Power Administration
Department of Energy
Portland, Oregon

Brigadier General Robert H. Griffin, Member
Division Engineer
Northwestern Division
Army Corps of Engineers
Portland, Oregon

CANADIAN ENTITY
Mr. Brian R. D. Smith, Chair
British Columbia
Hydro and Power Authority
Vancouver, British Columbia

BG Griffin succeeded MG Russell Fuhrman effective 3 December 1996.

The Entities have appointed Coordinators and two joint standing committees to assist in Treaty implementation activities. These are described in subsequent paragraphs. The primary duties and responsibilities of the Entities as specified in the Treaty and related documents are:

1. Plan and exchange information relating to facilities used to obtain the benefits contemplated by the Treaty.

2. Calculate and arrange for delivery of hydroelectric power to which Canada is entitled and the amounts payable to the U.S. for standby transmission services.

3. Operate a hydrometeorological system.

4. Assist and cooperate with the Permanent Engineering Board in the discharge of its functions.

5. Prepare hydroelectric and flood control operating plans for the use of Canadian storage.

6. Prepare and implement detailed operating plans that may produce results more advantageous to both countries than those that would arise from operation under assured operating plans.

7. The Treaty provides that the two governments may, by an exchange of notes, empower or charge the Entities with any other matter coming within the scope of the Treaty.

Entity Coordinators & Secretaries

The Entities have appointed members of their respective staffs to serve as coordinators or focal points on Treaty matters within their organizations.

The members are:

UNITED STATES ENTITY COORDINATORS

Mark W. Maher, Coordinator
Vice President, Generation Supply
Bonneville Power Administration
Portland, Oregon

John E. Velehradsky, Coordinator
Director, Engineering & Technical Services
Northwestern Division
Army Corps of Engineers
Portland, Oregon

Dr. Anthony G. White, Secretary
Regional Coordination
Generation Supply
Bonneville Power Administration
Vancouver, Washington

CANADIAN ENTITY COORDINATOR

Timothy J. Newton, Coordinator
Vice President, Market Development
POWEREX
Vancouver, British Columbia

Douglas A. Robinson, Secretary
Power Planning and Acquisition,
Power Supply
BC Hydro and Power Authority
Vancouver, British Columbia

Mr. Maher was appointed to succeed Ms. Judy Johansen effective 21 October 1996.

Mr. Robinson was appointed to succeed Mr. Graeme Simpson effective 1 November 1996.

Columbia River Treaty Operating Committee

The Operating Committee was established in September 1968 by the Entities and is responsible for preparing and implementing operating plans as required by the Columbia River Treaty, making studies and otherwise assisting the Entities as needed. The Operating Committee consists of eight members as follows:

UNITED STATES SECTION	CANADIAN SECTION
Gregory K. Delwiche, BPA, Co-Chair	Ralph D. Legge, B.C. Hydro, Chair
William E. Branch, ACE, Co-Chair	Kenneth R. Spafford, B.C. Hydro
Cynthia A. Henriksen, ACE	Henry C. Mark, B.C. Hydro
John M. Hyde, BPA	Dr. Thomas K. Siu, B.C. Hydro

Mr. Delwiche was appointed to succeed Mr. Mark W. Maher, effective 23 October 1996.

There were six meetings of the Operating Committee during the year. The dates, places and number of persons attending those meetings were:

Date	Location	Attendees
26 November 1996	Vancouver, B.C.	16
16 January 1997	Vancouver, WA	20
13 March 1997	Edmonds, B.C.	15
14 May 1997	Portland, OR	18
17 July 1997	Grand Coulee, WA.	14
18 September 1997	Portland, OR.	19

The Operating Committee coordinated the operation of the Treaty storage in accordance with the current hydroelectric and flood control operating plans. This aspect of the Committee's work is described in following sections of this report which have been prepared by the Committee with the assistance of others. During the period covered by this report, the Operating Committee began implementation of an agreement on "Resolving the Dispute on Critical Period Determination, the Capacity Entitlement for the 1998/99, 1999/00, and 2000/01 AOP/DDPB's, and Operating Procedures for the 2001/02 and Future AOP's". The Operating Committee also completed the 1 August 1997 through 31 July 1998 Detailed Operating Plans (DOP).

Columbia River Treaty Hydrometeorological Committee

The Hydrometeorological Committee was established in September 1968 by the Entities and is responsible for planning and monitoring the operation of data facilities in accord with the Treaty and otherwise assisting the Entities as needed. The Committee consists of four members as follows:

UNITED STATES SECTION	CANADIAN SECTION
Nancy L. Stephan, BPA Co-Chair	Eric Weiss, B.C. Hydro, Chair
Peter F. Brooks, ACE, Co-Chair	Heiki Walk, B.C. Hydro, Member

Ms. Nancy Stephan succeeded Mr. Gregory Delwiche as BPA Co-Chair as of 23 October 1996.

Mr. Eric Weiss succeeded Mr. Brian H. Fast as Canadian Chair as of 14 April 1997

Mr. Peter Brooks succeeded Mr. Doug Speers as Co-Chair as of 10 April 1997

There were several personnel changes this year. Two new US Co-Chairs were designated and the Canadian Chair was replaced. There were two meetings of the Hydrometeorological Committee, on 27 October 1996 and 14 April 14, 1997. The first meeting (No. 41) was hosted by the Corps in Portland, OR, and the second (No. 42) was hosted by BPA in Vancouver, WA. The committee reviewed the 1996 volume forecast results, hydromet station changes, and developments in telemetry. The Corps reported that its data collection computer will be replaced. Close coordination between the Entities will assure a smooth transition. The Canadian Entity presented its revised volume forecast procedures and submitted them for review by the U.S.

Permanent Engineering Board

Provisions for the establishment of the Permanent Engineering Board (PEB) and its duties and responsibilities are included in the Treaty and related documents. The members of the PEB are presently:

UNITED STATES SECTION	CANADIAN SECTION
Steven L. Stockton, Chair, Washington, D.C.	Daniel R. Whelan, Chair Ottawa, Ontario
Ronald H. Wilkerson, Member Missoula, Montana	John Allan, Member Victoria, British Columbia
Daniel R. Burns, Alternate Washington, D.C.	David Burpee , Alternate Ottawa, Ontario
George E. Bell, Alternate Portland, Oregon	Prad Kharé, Alternate Victoria, British Columbia
Richard J. DiBuono, Secretary Washington, D.C.	David Burpee, Secretary Ottawa, Ontario

Mr. Bell was appointed to replace Mr. Thomas Weaver as Alternate on 27 January 1997.
Mr. Kharé was appointed to replace Mr. Jack Farrell as Alternate on 21January 1997.

In general, the duties and responsibilities of the PEB are to assemble records of flows of the Columbia River and the Kootenay River at the international boundary; report to both governments if there is deviation from the hydroelectric or flood control operating plans, and if appropriate, include recommendations for remedial action; assist in reconciling differences that may arise between the Entities; make periodic inspections and obtain reports as needed from the Entities to assure that Treaty objectives are being met; make an annual report to both governments and special reports when appropriate; consult with the Entities in the establishment and operation of a hydrometeorological system; and, investigate and report on any other Treaty related matter at the request of either government.

The Entities continued their cooperation with the PEB during the past year by providing copies of Entity agreements, operating plans, downstream power benefit computations, corrections to hydrometeorological documents, and the annual Entity report to the Board for their review. The annual joint meeting of the PEB and the Entities was held on the morning of 4 February 1997 in Vancouver, British Columbia.

PEB Engineering Committee

The PEB has established a PEB Engineering Committee (PEBCOM) to assist in carrying out its duties. The members of PEBCOM at the end of the period of this report were:

UNITED STATES SECTION
Richard J. DiBuono, Chair
Washington, D.C.
Robert K. Johnson, Member
Golden, CO
Earl E. Eiker, Member
Washington, D.C.
James Barton, Member
Portland, OR
James Fodrea, Member
Boise, ID
Stephan J. Wright, Alternate Member
Washington, D.C.

CANADIAN SECTION
Roger McLaughlin, Chair
Victoria, British Columbia
David Burpee, Member
Ottawa, Ontario
Bala Balachandran, Member
Victoria, British Columbia
Myriam Boudreault, Member
Ottawa, Ontario

Mr. Fodrea was appointed a Member to replace Mr. Gary Fuqua in January of 1997.

Ms. Boudreault was appointed a Member to replace Mr. Bruno Gobeil on 1 September 1997.

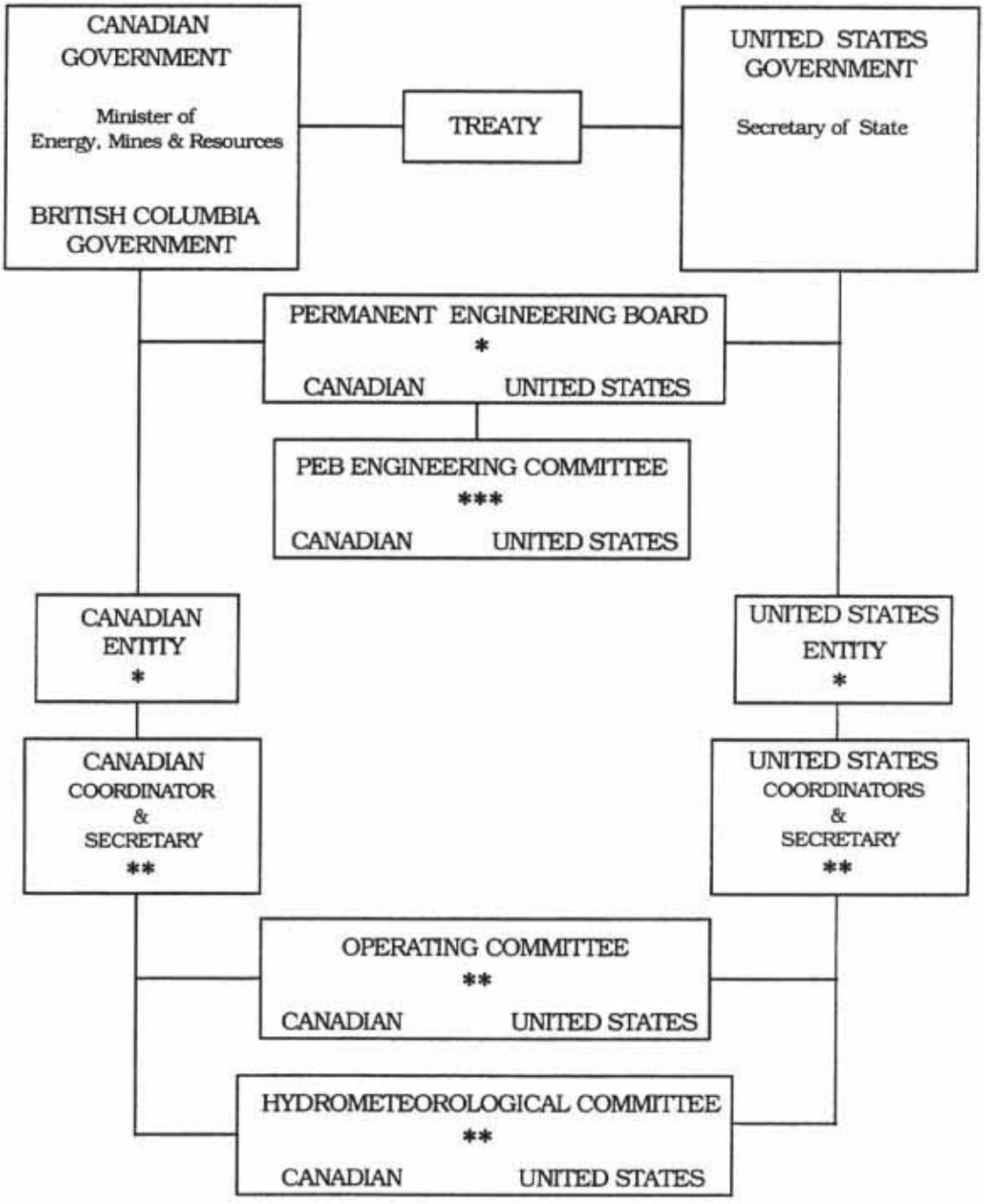
Mr. McLaughlin was appointed Chair in January of 1997

International Joint Commission

The International Joint Commission (IJC) was created under the Boundary Waters Treaty of 1909 between Canada and the U.S. Its principal functions are rendering decisions on the use of boundary waters, investigating important problems arising along the common frontier not necessarily connected with waterways, and making recommendations on any question referred to it by either government. If a dispute concerning the Columbia River Treaty could not be resolved by the Entities or the PEB it may be referred to the IJC for resolution before being submitted to a tribunal for arbitration.

The IJC has appointed local Boards of Control to insure compliance with IJC orders and to keep the IJC currently informed. There are three such boards west of the continental divide. These are the International Kootenay Lake Board of Control, the International Columbia River Board of Control, and the International Osoyoos Lake Board of Control. The Entities and their committees conducted their Treaty activities during the period of this report so that there was no known conflict with IJC orders or rules.

COLUMBIA RIVER TREATY ORGANIZATION



* Established by TREATY ** Established by ENTITY *** Established by PEB

III Operating Arrangements

Power and Flood Control Operating Plans

The Columbia River Treaty requires that the reservoirs constructed in Canada be operated pursuant to flood control and hydroelectric operating plans developed thereunder. Annex A of the Treaty stipulates that the United States Entity will submit flood control operating plans and that the Canadian Entity will operate in accordance with flood control storage diagrams or any variation which the Entities agree will not be adverse to the desired aim of the flood control plan. Annex A also provides for the development of hydroelectric operating plans six years in advance to furnish the Entities with an Assured Operating Plan for Canadian storage. In addition, Article XIV.2.k of the Treaty provides that a Detailed Operating Plan may be developed to produce more advantageous results through the use of current estimates of loads and resources. The Protocol to the Treaty provides further detail and clarification of the principles and requirements of the Treaty.

The "Principles and Procedures for the Preparation and Use of Hydroelectric Operating Plans" dated December 1991 together with the "Columbia River Treaty Flood Control Operating Plan" dated October 1972, were cited as reference documents in the development of the AOP and DOP plans and operations for Treaty storage during the period covered by this report. These documents were previously approved by the Entities. The flood control Storage Reservation Diagram for Libby contained in the 1972 Flood Control Plan, was amended by agreement of the Operating Committee to that contained in the U.S. Army Corps of Engineers (ACE) "Review of Flood Control, Columbia River Basin, Columbia River & Tributaries Study, CRT-63", dated June 1981.

The planning and operation of Canadian Storage as discussed on the following pages is for the operating year, 1 August through 31 July. Most of the hydrographs and reservoir charts in this report are for a 13 month period, July 1996 through July 1997.

Assured Operating Plan

The Assured Operating Plan, dated February 1992, established Operating Rule Curves for Duncan, Arrow, and Mica during the 1996-97 operating year. The Operating Rule Curves provided guidelines for draft and refill. They were derived from Critical Rule Curves, Assured Refill Curves, Upper Rule Curves, and Variable Refill Curves, consistent with flood control requirements, as described in the 1991 Principles and Procedures document. The Flood Control Storage Reservation Curves were established to conform to the Flood Control Operating Plan of 1972.

Determination of Downstream Power Benefits

For each operating year, the Determination of Downstream Power Benefits resulting from Canadian storage is made six years in advance in conjunction with the Assured Operating Plan. For operating year 1996-97 the estimate of benefits resulting from operating plans designed to achieve optimum operation in both countries was less than that which would have prevailed from an optimum generation in the United States only. Therefore, in accordance with Sections 7 and 10 of the Canadian Entitlement Purchase Agreement, the Entities agreed that the United States was entitled to receive 0.9 average megawatts of energy and no dependable capacity during the period 1 August 1996 through 31 March 1997, and 2.8 average megawatts of energy and no dependable capacity during 1 April 1997 through July 1997. Suitable arrangements were made between the Bonneville Power Administration and B.C. Hydro for delivery of this energy.

Detailed Operating Plan

During the period covered by this report, the Operating Committee used the 1 August 1996 through 31 July 1997 "Detailed Operating Plan for Columbia River Treaty Storage" (DOP), dated August 1996, and the 1 August 1997 through 31 July 1998 DOP signed 30 July 1997 and dated August 1997, to guide storage operations. The DOP established criteria for determining the Operating Rule Curves for use in actual operations. The DOP used the AOP critical rule curves for Canadian Projects. The Variable Refill Curves and flood control requirements subsequent to 1 January 1997 were determined on the basis of seasonal volume runoff forecasts during actual operation. The regulation of the Canadian storage was directed by the Operating Committee on a weekly basis throughout the year.

Entity Agreements

During the period covered by this report, one joint US-Canadian arrangement was approved by the Entities. There were also five agreements between the U.S. Entity and various Public Utility Districts. The following tabulation indicates the date each of these were signed and gives a description of the agreement:

Date Agreement Signed by Entities/PUD	Description
20 November 1996	Columbia River Treaty Entity Agreement on Aspects of the Delivery of the Canadian Entitlement for April 1, 1998 Through September 15, 2024 Between the Canadian Entity and the United States Entity
29 April 1997	Canadian Entitlement Allocation Extension Agreement executed by the United States of America acting by and through the Bonneville Power Administrator acting in the capacity of Bonneville Power Administrator and acting for and on behalf of the United States Entity and Public Utility District No. 2 of Grant County, Washington (Priest Rapids Project)
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Operating Committee Agreements

During the period covered by this report, two joint US-Canadian agreements were approved by the Operating Committee. The following tabulation indicates the dates they were signed, gives descriptions of the agreements, and cites the authorities:

Date Agreement Signed by Committee	Description	Authority
16 January 1997	Columbia Treaty Operating Committee Agreement on Operation of Treaty Storage for Enhancement of Whitefish Spawning for January 1 through April 30, 1997	Detailed Operating Plan, 1 August 1996 through 31 July 1997, dated August 1996
4 April 1997	Columbia Treaty Operating Committee Agreement on Operation of Treaty Storage for Enhancement of Trout Spawning for March 1 through July 31, 1997	Detailed Operating Plan, 1 August 1996 through 31 July 1997, dated August 1996
4 August 1997	Agreement among the Columbia Treaty Operating Committee and the Bonneville Power Administration and British Columbia Hydro and Power Authority on the Operation of Canadian Treaty and Libby Storage Reservoirs and Exchanges of Power for the Period 1 August 1997 through 16 January 1998	Detailed Operating Plan, 1 August 1997 through 31 July 1998, approved July 1997 and dated August 1997
18 September 1997	Columbia River Treaty Operating Committee Agreement on Operation of Treaty Storage for Nonpower Uses For January 1 through July 31, 1998	Detailed Operating Plan, 1 August 1997 through 31 July 1998, approved July 1997 and dated August 1997

Long Term Non-Treaty Storage Contract

In accordance with the 9 July 1990 Entity Agreement which approved the contract between B.C. Hydro and BPA relating to the initial filling of non-Treaty storage, coordinated use of non-Treaty storage, and Mica and Arrow refill enhancement, the Operating Committee monitored the storage operations made under this Agreement throughout the operating year to insure that they did not adversely impact operation of Canadian storage required by the Detailed Operating Plan.

IV Weather and Streamflow

Weather

Summer 1996 was pleasant across the Columbia Basin. The July weather patterns consisted of an upper-level ridge along the west coast, resulting in warm weather and generally below normal rainfall. This ridge gave way to minor disturbances near the 4th and again after mid-month resulting in minor showers.

This pattern continued until mid-October when a low pressure system became anchored in the Gulf of Alaska, sending a series of storms into the Northwest, beginning the snow accumulation season. This continued through mid-November when the first major storm of the year moved through the Northwest. During November 18-19, a strong moisture-laden system tracked through the region. Two-day total rainfalls exceeding 2 inches were common across northern and western Oregon, southwestern Washington, and the northern part of Idaho. Amounts over 6 inches covered large sections of western Oregon and the southern Cascades. Between 10 and 14 inches deluged a few sites in southwestern Oregon. Over the next few days rainfall slackened, but significantly cooler air interacted with persistent precipitation and resulted in some heavy snowfall at middle and upper elevation sites and scattered ice pellets and freezing rain in northeastern Washington and northern Idaho. Moderate but steady precipitation continued until Christmas when heavy rainfall again visited the region. A weather pattern, with its source in the equatorial Pacific, sent a series of warm and wet storm systems into the Northwest that lasted through New Years Day. This Pineapple Express generated a pronounced snowmelt which, in conjunction with the heavy rains, produced widespread flooding in Washington, Oregon and Idaho. Light to moderate precipitation returned in early January and continued through March.

The snowmelt season began with a little more snow. April suffered from very cold weather with a Yukon air-mass sweeping into western Montana and colliding with marine air to produce record snowfall in both Missoula and Kalispell. Other parts of the Northwest continued to be subjected to scattered showers for the rest of the month and continuing into early May. Late April was accented by two unusual storms: the remnants of typhoon Esa and the remnants of tropical storm Jimmy. By May 8, a strong high pressure ridge developed, drawing warm air into the region, resulting in rapid snowmelt

and flooding in the Clark Fork, Yaak, Fisher, Pend Oreille, Spokane, Tonasket, Yakima and Snake basins. By the last week of the month the high pressure system was replaced by a more westerly flow that produced showers throughout the basin. This cool, wet weather continued into July and continued through the summer season.

The final monthly precipitation indices for the Columbia Basin above The Dalles are shown below for the 1997 Water Year. These indices are based on 60 stations and are computed at the end of each month after all the data are collected. Also shown in the table are the monthly indices as a percent of the 30-year normal (1961-90).

WY 97 Precipitation Index at The Dalles

Month	Precipitation (in.)	(%)	Month	Precipitation (in.)	(%)
Oct.	2.15	131	Apr	1.97	123
Nov	3.52	129	May	1.75	96
Dec	5.27	175	Jun	2.06	114
Jan	3.67	124	Jul	2.07	190
Feb	1.56	74	Aug	0.97	78
Mar	2.93	155	Sep	2.02	144
			Annual	29.94	128

Streamflow

The observed inflow and outflow hydrographs for the Treaty reservoirs for the period 1 July 1996 through 31 July 1997 are shown on Charts 6 through 9. Observed flows with the computed unregulated flow hydrographs for the same 13-month period for Kootenay Lake, Columbia River at Birchbank, Grand Coulee, and The Dalles are shown on Charts 10, 11, 12, and 13, respectively. Chart 14 is a hydrograph of observed and two unregulated flows at The Dalles during the April through July 1997 period, including a plot of flows occurring if regulated only by the Treaty reservoirs.

Composite operating year unregulated streamflows in the basin above The Dalles were much higher than the past few years, although with a slow start as September, October and November 1996 were below normal at 90%. March and May were the high months, being in the 160-155% of normal

range. The August 1996 through July 1997 runoff for The Dalles was 191.0 Maf, 140% of the 1961-90 average. The peak regulated discharge for the Columbia River at The Dalles was 570,700 cfs on 15 June 1997. The 1996-97 monthly unregulated streamflows and their percent of the 1961-90 average monthly flows are shown in the following table for the Columbia River at Grand Coulee and at The Dalles. These flows have been corrected to exclude the effects of regulation provided by storage reservoirs.

	Columbia River at Grand Coulee in cfs		**Columbia River at The Dalles in cfs**	
Time Period	Natural Flow	Percent of Average	Natural Flow	Percent of Average
Aug 96	112,870	108	144,450	105
Sep 96	62,180	96	93,570	97
Oct 96	50,370	104	87,110	101
Nov 96	43,460	100	88,380	97
Dec 96	40,680	96	113,570	120
Jan 97	57,150	139	186,850	190
Feb 97	48,830	105	172,030	148
Mar 97	92,830	157	235,720	166
Apr 97	161,550	139	334,500	149
May 97	409,570	155	681,230	161
Jun 97	445,720	135	694,490	140
Jul 97	242,670	127	330,910	129
Operating Year	147,320	131	263,570	140
Water Year	149,600	133	267,940	142

Seasonal Runoff Forecasts and Volumes

Observed 1997 April through August runoff volumes, adjusted to exclude the effects of regulation of upstream storage, are listed below for eight locations in the Columbia Basin:

Location	Volume In 1000 Acre-Feet	Percent of 1961-90 Average
Libby Reservoir Inflow	7,852	123
Duncan Reservoir Inflow	2,405	117
Mica Reservoir Inflow	12,524	109
Arrow Reservoir Inflow	23,262	114
Columbia River at Birchbank	50,408	124
Grand Coulee Reservoir Inflow	83,340	137
Snake River at Lower Granite Dam	35,287	153
Columbia River at The Dalles	133,133	143

Forecasts of seasonal runoff volume, based on precipitation and snowpack data, were prepared in 1997 for a large number of locations in the Columbia River Basin and updated each month as the season advanced. Table 1 lists the April through August volume inflow forecasts for Mica, Arrow, Duncan, and Libby projects, and for unregulated runoff for the Columbia River at The Dalles. Also shown in Table 1 are the actual volumes for these five locations. The forecasts for Mica, Arrow, and Duncan inflow were prepared by B.C. Hydro, and those for the lower Columbia River and Libby inflows were prepared by the National Weather Service and River Forecast Center in cooperation with the Corps of Engineers, National Resource Conservation Service, Bureau of Reclamation and B.C. Hydro. The 1 April 1997 forecast of January through July runoff for the Columbia River above The Dalles was 149.0 Maf and the actual observed runoff was 159.0 Maf.

The following tabulation summarizes monthly forecasts since 1970 of the January through July runoff for the Columbia River above The Dalles compared with the actual runoff measured in millions of acre-feet (Maf). The average January-July runoff for the 1961-1990 period is 105.9 Maf.

The Dalles Volume Runoff Forecasts in Maf (Jan-Jul)

Year	Jan	Feb	Mar	Apr	May	June	Actual
1970	82.5	99.5	93.4	94.3	95.1		95.7
1971	110.9	129.5	126.0	134.0	133.0	135.0	137.5
1972	110.1	128.0	138.7	146.1	146.0	146.0	151.7
1973	93.1	90.5	84.7	83.0	80.4	78.7	71.2
1974	123.0	140.0	146.0	149.0	147.0	147.0	156.3
1975	96.1	106.2	114.7	116.7	115.2	113.0	112.4
1976	113.0	116.0	121.0	124.0	124.0	124.0	122.8
1977	75.7	62.2	55.9	58.1	53.8	57.4	53.8
1978	120.0	114.0	108.0	101.0	104.0	105.0	105.6
1979	88.0	78.6	93.0	87.3	89.7	89.7	83.1
1980	88.9	88.9	88.9	89.7	90.6	97.7	95.8
1981	106.0	84.7	84.5	81.9	83.2	95.9	103.4
1982	110.0	120.0	126.0	130.0	131.0	128.0	129.9
1983	110.0	108.0	113.0	121.0	121.0	119.0	118.7
1984	113.0	103.0	97.6	102.0	107.0	114.0	119.1
1985	131.0	109.0	105.0	98.6	98.6	100.0	87.7
1986	96.8	93.3	103.0	106.0	108.0	108.0	108.3
1987	88.9	81.9	78.0	80.0	76.7	75.8	76.5
1988	79.2	74.8	72.7	74.0	76.1	75.0	73.7
1989	101.0	102.0	94.2	99.5	98.6	96.9	90.6
1990	86.5	101.0	104.0	96.0	96.0	99.5	99.7
1991	116.0	110.0	107.0	106.0	106.0	104.0	107.1
1992	92.6	89.1	83.5	71.2	71.2	67.8	70.4
1993	92.6	86.5	77.3	76.6	81.9	86.1	88.0
1994	79.7	76.3	78.1	73.2	75.5	76.4	75.0
1995	101.0	99.6	94.3	99.6	99.6	97.9	104.0
1996	116.0	122.0	130.0	126.0	134.0	141.0	139.3
1997	138.0	145.0	142.0	149.0	153.0	159.0	159.0

V Reservoir Operation

General

The 1996-97 operating year was characterized by above, to much above normal precipitation for the Columbia Basin above The Dalles except for August - September 1996, February 1997 and May 1997. December 1996 and July 1997 had 175% and 190% of normal precipitation. The January - July volume observed at The Dalles was 159 million acre feet (Maf) which was the highest in 1961 - 1990.

The operating year began with the coordinated system reservoirs officially filling to 99.7 percent of storage capacity on 31 July 1996. As a result, first year firm load carrying capability (FLCC) was adopted for the 1996-97 operating year.

The 1 January 1997 water supply forecast for The Dalles was 138.0 Maf for the January-July period, or 130 percent of the 1961-90 average. Subsequent forecasts through March reflected an increasing trend to 134 percent, with the April forecast increasing further to 141 percent. May and June saw increasing amounts to 150 percent of normal. Actual runoff for January-July was 150 percent of normal.

During the 10 April-31 August salmon flow augmentation period, U.S. projects were used to augment flows at Lower Granite and McNary. The National Marine Fisheries Service's Biological Opinion, released in early March 1995, listed target flows that were variable based on runoff volume forecasts. The target flows were:

- Lower Granite, 85,000-100,000 cfs during 10 April - 15 June, and 50,000-55,000 cfs during 23 June - 31 August;
- McNary, 220,000-260,000 cfs during 20 April - 30 June, and 200,000 cfs during 1 July-31 August.

Provision for adjusting target flows based on runoff volume forecasts was based on a sliding scale with Lower Granite at 100,000 cfs and 53,500 cfs for the two periods. McNary was at 260,000 cfs for the first period. The second period is set at 200,000 cfs and does not vary with runoff forecasts.

Daily flood control regulation was required once during the winter of 1996-1997 season. This occurred in early January. Treaty projects' outflows were not affected as there was sufficient storage available in Grand Coulee to achieve flood control objectives. The peak flow at The Dalles during the flood event was held to 321,500 cfs on 5 January 1997.

The system reached 99.1 percent of its full energy capacity in the Actual Energy Regulation (AER) on 31 July 1997, resulting in first-year FLCC being adopted for the 1996-97 operating year.

Mica Reservoir

As shown in Chart 6, the Mica Reservoir (Kinbasket Lake) level was at elevation 2470.4 feet, 4.6 feet below full pool elevation 2475 feet with the corresponding Mica Treaty storage at 3356.2 ksfd (6.7 Maf) or 95 percent of full on 31 July 1996.

The local inflows into Mica reservoir averaged 40.7 kcfs in August, reducing to 18.8 kcfs in September, and then dropping off to about 5 kcfs by 1996 year end. Mica Treaty storage continued to fill during August reaching full Treaty Storage of 3529.2 ksfd (7.0 Maf) on 12 August. Mica reservoir remained above full pool between 12 to 19 August and water was spilled to maintain the level to full pool. The reservoir exceeded full pool elevation on 31 August and 1 September 1996 and reached respective elevations of 2475.3 and 2475.4 feet on these days. The Mica Treaty flex reached 418 ksfd on 31 August. The reservoir level remained above elevation 2460 feet until early November.

Actual Mica discharges were fairly high through August with the average turbine discharge at 70% of the maximum in the year. This corresponded to an average turbine discharge of 30.3 kcfs in August. The turbine discharge decreased to about 26 kcfs in months of September and October. Mica Powerhouse discharges during November were high with an average of 37.4 kcfs. In December, the discharges averaged about 29 kcfs, and the reservoir drafted to elevation 2427.2 feet by 31 December 1996. Treaty storage at end of December was 2142.7 ksfd (4.2 Maf).

In January 1997, the inflows dropped off to one kcfs or less, gradually increasing between February to mid-April 1997 before the start of spring freshet. The B.C. Hydro Non-Treaty Storage reached 75% of the full amount. Mica powerhouse discharges for January averaged around 26.4 kcfs and the generation from Mica continued to decrease over winter 1997. The reservoir drafted to elevations 2401.1 feet by 28 February, with Treaty Storage at 1007.1 ksfd and Mica Treaty flex at 326 ksfd on that date. The B.C. Hydro NTSA remained unchanged at 851 ksfd in February and March. The Mica Reservoir continued to draft during March - April and reached its lowest level for the 1996-97 year at elevation 2383.6 feet on 25 April, 1997. This level was 21 feet lower than the previous year's low level. Mica Treaty storage reached a minimum of 56 ksfd (0.1 Maf) on 30 April with Mica flex reaching 25 ksfd.

The Mica turbine discharge in April was about 15 kcfs dropping to an average of about 3 to 3.5 kcfs in May and June 1997 when the corresponding plant generation was less than 10% of plant capacity. With the start of the spring freshet in early May, Mica discharges were reduced, and the reservoir refilled quickly. At the end of May, the Mica Treaty flex had been increased to 83 ksfd. The Mica Treaty discharge was 10 kcfs for the months of May and June, allowing Treaty storage to refill to 3336.9 ksfd (6.6 Maf, 94% of full) by 31 July. Local inflows were the highest in June and July averaging about 66 kcfs and 59 kcfs respectively. Actual Mica discharges during July averaged 20 kcfs, resulting in the Mica Treaty flex of 29 ksfd by the end of July 1997 and the reservoir had refilled to elevation 2471.1 feet. The plant discharge increased to 21 kcfs with plant generation at about 45% of plant capacity in July, 1997.

In August 1997, the Mica Reservoir level remained within a foot of full pool elevation between 8 August to 19 August before receding. The Mica Treaty storage reached full at 3529 ksfd on 12 August 1997. The inflows dropped off to under 30 kcfs by mid-September 1997.

Revelstoke Reservoir

During the 1996-97 operating year, the Revelstoke project was operated generally as a run-of-river plant, with the reservoir level maintained within 4.8 feet of its normal full pool level, elevation 1880 feet. During the spring freshet, March through July, the reservoir was occasionally operated as low as elevation 1875.4 feet to provide additional operational space to control high local inflows.

Arrow Reservoir

As shown in Chart 7, the Arrow Reservoir level reached its maximum actual elevation of 1442.6 feet on 10 July 1996. The Reservoir had drafted slightly to elevation 1442.4 feet by 31 July but the treaty storage accounting for Mica/Arrow was full. The reservoir continued to draft in August and gradually drafted to elevation 1428.4 feet by the end of September.

Arrow discharges decreased over the autumn months from an average of 55 kcfs in October to an average of 45 kcfs in December. The local inflows decreased from 31.9 kcfs at the end of July to 14.6 in August and then dropped to 6.3 by the 1996 year end. The Arrow Reservoir drafted to elevation 1418.1 feet by 31 December 1996 with the Arrow Treaty storage on that date at 2446.5 ksfd (4.9 Maf) or 68% of full.

In early January, B.C. Hydro requested that Arrow outflows be selectively reduced below Treaty requests to keep river levels at acceptable and maintainable levels during whitefish spawning and later emergence. BPA agreed to this under terms of the Non-Power Uses Agreement. The treaty requests were reduced during this period for a total of 202 ksfd held back. This storage was later returned and the Canadian Treaty Storage returned to the Treaty Storage Regulation (TSR) levels. Arrow Reservoir continued to draft during the January - March period when the local inflows ranged between 5.0 to 5.8 kcfs.

Arrow Reservoir reached its lowest level for the year at 1389.5 feet on 31 March 1997. Arrow Treaty storage reached its minimum at 392 ksfd (0.8 Maf) or 11% of full at the end of March 1997.

During April the Arrow discharge was kept between 15 - 20 kcfs in an attempt to insure that rainbow trout would not spawn at higher river levels. Several trout redds, which were de-watered, were kept wetted for a limited time using a pump and sprinkler system.

During April through June, Arrow was operated under the terms of two Operating Committee agreements, Operation of Treaty Storage for Enhancement of Whitefish Spawning for January 1 through April 30, 1997, and Operation of Treaty Storage for Enhancement of Trout Spawning for March 1 through July 31, 1997. These agreements allowed the Arrow project flows to be maintained and avoid de-watering rainbow trout redds. With the low discharge throughout April and most of May, and start of

spring freshet in mid-May when high inflows occurred, the Arrow Reservoir level rose to elevation 1397.6 feet by 30 April and 1419.8 feet by 31 May. The reservoir continued to fill in June due to higher inflows.

With the start of the Spring freshet, increasing discharges from the Kootenay River created a backwater effect on the Norns Creek Fan, a prime spawning location for rainbow trout. Discharge from Arrow was held at 20 kcfs for the first three weeks of May and gradually increased throughout the month of June. Arrow reached a level of 1437.4 feet by 30 June 1997. Except for a few days near the end of June, Arrow reservoir levels slightly exceeded the Treaty flood control curve levels during June and early July.

The Arrow discharge was increased substantially in July as Arrow Treaty storage neared full and the Reservoir reached its highest level for the year at elevation 1444.1 feet on 31 July 1997, slightly above full pool elevation 1444 feet. The Arrow discharge peaked for the summer at 94.6 kcfs on 17 July. The Arrow Treaty storage content continued to fill and reached full (7.1 Maf) on 31 July. With the increased Arrow discharges in late July and August, the Arrow Reservoir drafted to elevation 1439 feet approximately by the end of August.

To minimize spill at the Canadian Kootenay River plants and maintain Koocanusa reservoir water levels in Canada for resident fish and recreation, the Canadian and U.S. Entities agreed to a Libby-Arrow water transfer for late summer of 1997. Under the agreement, Libby discharges were reduced by a total of 190 ksfd through August and instead, an equal amount of water was released from Arrow reservoir. This Arrow water effectively stored in Libby will be returned to Arrow Reservoir in the October to December 1997 period as part of the agreement.

Duncan Reservoir

As shown in Chart 8, the Duncan reservoir level was at elevation 1892.2 feet, slightly above full pool on 31 July 1996. The reservoir remained within 0.5 feet of full pool elevation 1892.0 feet and reached full Treaty storage (within 1/10th ksfd) on several days during August 1996.

During the month of September, Duncan discharged an average of 5.5 kcfs to maintain the Kootenay Lake levels and Kootenay Lake flows. The project discharge was reduced to an average of 3.5 kcfs in October and remained there for most of November, dropping off to 2 kcfs in first half of December.

Higher discharges between mid-December to February were necessary to again support Kootenay Lake levels and flows. The Duncan Reservoir level was at elevation 1857.4 feet (58% of full) on 31 December 1996. These operations contributed to Duncan reservoir levels remaining at or below the flood control curve in this operating year.

During January, the Duncan discharge increased to about 6 kcfs. The reservoir was drafted throughout February to mid-March to meet Kootenay Lake IJC levels. The Duncan reservoir exceeded its Treaty flood control curve slightly near the end of February and then continued to draft another 6 feet below the flood control curve between March to 1 May 1997. The reservoir reached its lowest level for the year at elevation 1796.6 feet (2.2 feet above empty) on 1 May 1997.

The Duncan discharge was reduced to minimum, 100 cfs, on 2 May to begin refilling the reservoir. The reservoir reached elevation 1834.4 feet by 31 May and elevation 1879.7 feet by 30 June. Duncan remained on minimum discharge until 4 July. At that time discharge was increased to slow the rate of reservoir refill. The Duncan reservoir reached full pool at elevation 1892.0 feet on 15 July 1997 and exceeded it by 0.1 feet to 1892.1 feet on 30 July 1997.

Duncan passed inflow for the remainder of August to maintain the reservoir near full pool. On 1 September, the Duncan discharge was increased to start drafting the reservoir and fill Kootenay Lake.

Libby Reservoir

As shown in Chart 9, Lake Koocanusa started the operating year at Elev. 2458.96 feet, 2.36 feet higher than last year and 0.04 feet below full. This was the lake's peak summer level.

The first 12 days of August saw Libby releasing 24 kcfs reducing to 12-14 kcfs for the remainder of the month because of high water difficulties near Bonners Ferry. Libby did not release its full BiOp volume allocation due to the Arrow Libby swap of nearly 200 ksfd, and this water was delivered from Arrow Lakes instead. September outflows were in the 8-12 kcfs range for an on-going Montana Fish, Wildlife & Parks fishery study. The observed pool level on 30 September 1996 was Elev. 2448.7 feet, while the AER level was Elev. 2432.3 feet.

In October Libby was used for weekly load shaping. Weekend flows were 8 kcfs Thursdays through Sundays, and the weekday flows were 14.5 kcfs. By October 21 weekly load following stopped and the project released 14.5 kcfs for nearly the rest of the month. The reservoir drafted only nine feet in October to elevation 2439.26 feet. Libby operated for power, fish monitoring studies, and flood control in November and was drafted about 14 feet. Libby maintained full load (20 kcfs on 4 units - 1 unit was out of service due to a forced outage) for the whole month of December except for 4 days over the Christmas holiday when loads were down and a fish monitoring study was conducted (4 kcfs). The project was drafted to 2402.13 feet by the end of December which is 8.87 feet below the Upper Rule Curve, to try to eliminate possible spill in January to get down to anticipated low flood control elevations in 1997.

On 1 January and 1 February, the April - August volume forecasts were 112% and 115% of normal, respectively. In both January and February, the project was operated for flood control. All four available units were operated at their maximum capacity both months. February inflows were only 101% of normal, and on 1 March, the April - August volume forecast was reduced to 110% of normal. Outflows in March were reduced from 18 kcfs to 7 kcfs weekly average to reflect the new volume forecast. Between 17 and 21 March and 1 - 10 April, a flat 4,000 cfs and 6,000 cfs flow was maintained to meet flood control/refill needs as well as accommodate the State of Idaho's request to facilitate rainbow trout spawning. Project releases in April and May of 8.7 kcfs and 13 kcfs averaging considered flood control needs as well as refill to provide both sturgeon flows in June and salmon flows in August.

The U.S. Fish and Wildlife Service requested three pulsing operations from Libby up to full powerhouse capacity to enhance sturgeon spawning above Bonners Ferry where the hard river bottom is more conducive to sturgeon egg survival. These pulses were requested to take place when the water temperature at Bonners Ferry reached 10, 12 and 14 degrees Celsius. The first pulse was accommodated June 5 - 19. The second pulse was performed June 24 - 28. A third pulse was not done due to fear of filling/spilling in June. There was a lot of rain during the month of June and therefore several "natural pulses" of sturgeon water occurred.

Throughout the month of July the temperature remained below normal and precipitation was slightly below normal. As a result, the water supply forecast was not manifesting itself in the form of runoff, but evaporation. By July 16 the outflow was ramped down to 10 kcfs and the reservoir elevation at the end of the month was near 2453 feet (6 feet from full). The steady 10 kcfs was requested by the Libby continued to release 10 kcfs until the Libby/Arrow swap was initiated on August 13 and the outflow was increased to 14.5 kcfs. 190 ksfd of water was swapped (stored in Libby while 190 ksfd was

released from Arrow). The maximum reservoir elevation reached was 2454.82 feet on August 12. The end of August elevation was 2450.12 feet, less than 10 feet from full.

September outflows were weekly shaped - higher flows during the week and lower flows during the weekend. This operation was a concession by the power industry to not daily shape flows, as has been done in the past, to help improve the general health of the river. The observed pool level on 30 September 1997 was Elev. 2447.38 feet. The April - August seasonal runoff was 123 percent of normal.

Kootenay Lake

As shown in Chart 10, the level of Kootenay Lake at Queens Bay was at elevation 1746.4 feet on 31 July 1996. The level at Nelson reached below the summer IJC maximum of elevation 1743.32 feet on 12 August. Discharges were adjusted to pass inflow during August.

For the month of September, the Kootenay Lake discharge was adjusted to keep the downstream Brilliant plant at full load without spill, approximately 19 kcfs. By 31 December 1996 the lake was near full pool at elevation 1744.8 feet (about 0.5 feet form IJC level).

Beginning in January, Kootenay Lake was drafted to avoid violating the IJC order. The lake discharges were kept slightly above the inflows during the period January to mid-March approximately to comply with the IJC levels. The lake level dropped to a low of 1739.7 feet on 19 March and thereafter started to fill. Local inflows into Kootenay Lake peaked on 23 March at 53.9 kcfs when the lake discharge was at about 26 kcfs and the lake exceeded the IJC level between 20 March to 1 April, 1997 by up to one foot in this period. This was not a Treaty violation, however as the exceedences were due to extraordinary natural high inflow conditions and are allowable under the 1938 IJC Order on Kootenay Lake. The outflows from Duncan were therefore, further reduced to a minimum to lower the lake level. The lake level remained below the IJC levels for the remainder of the 1996 - 97 year.

Inflows to Kootenay Lake increased starting mid-April and the lake reached its peak level for the year at elevation 1752.9 feet on 12 June. The lake level remained close to the peak until 16 June 1997 before starting to drop off. With receding runoff in the latter part of June and reduced Libby discharge in July, Kootenay Lake drafted, with the lowest summer lake elevation occurring on 1 September at elevation 1743.6 feet. The Nelson gauge level dropped below the IJC summer level of elevation 1743.32 feet on 12 August 1997. Lake discharges were adjusted to keep the Nelson gauge level below elevation 1743.32

feet until the end of August. During September, due to late occurrences of heavy rainfall, lake discharges were adjusted to gradually refill it to the IJC level of 1745.32 feet by 7 January 1997. The lake was operated to gradually refill to allow accommodation of any high inflows yet to come. On 30 September 1997, the lake reached an elevation of 1744.42 feet.

Storage Transfer Agreements

In the 1996-97 operating year, the Canadian and U.S. Entities entered into a storage transfer agreement for the summer of 1997 in which increased releases from Canadian Treaty projects were used to reduce the outflow from Libby. This operation resulted in about 190 ksfd less water being released from Libby during August, reducing the amount of spill at Canadian powerplants on the Kootenay River, and maintaining higher Lake Koocanusa levels in Canada and the U.S. than would otherwise have resulted/occurred, thus improving recreation. The additional water taken out of Columbia River Treaty Storage will be returned by 16 January 1998.

VI Power and Flood Control Accomplishments

General

During the period covered by this report, Duncan, Arrow, and Mica reservoirs were operated in accordance with the Columbia River Treaty. Specifically, the operation of the reservoirs was governed by the:

1. "Detailed Operating Plan for Columbia River Treaty Storage - 1 August 1996 through 31 July 1997," dated August 1996.
2. "Detailed Operating Plan for Columbia River Treaty Storage - 1 August 1997 through 31 July 1998," dated 1 August 1997.
3. "Columbia River Treaty Flood Control Operating Plan," dated October 1972.
4. "Columbia River Treaty Entity Agreement On Operation of Treaty Storage for Non-Power Uses for January 1, 1997 through July 31, 1997," dated 16 January 1997.
5. "Agreement among the Columbia River Treaty Operating Committee and the Bonneville Power Administration and British Columbia Hydro and Power Authority on the Operation of Canadian Treaty and Libby Storage Reservoirs and Exchanges of Power for the Period 1 August 1997 through 16 January 1998," dated 4 August 1997.

Consistent with all Detailed Operating Plans (DOP) prepared since the installation of generation at Mica, the 1996-97 DOP was designed to achieve optimum power generation at-site in Canada and downstream in Canada and the United States, in accordance with Annex A, paragraph 7 of the Treaty. The 1996-97 Assured Operating Plan, prepared in February 1992, was used as the basis for the preparation of the 1996-97 DOP.

During the period covered by this report, Libby reservoir was operated in accordance with the 1972 "Columbia River Treaty Flood Control Operating Plan," as amended by the U.S. Army Corps of Engineers (ACE) "Review of Flood Control, Columbia River Basin, Columbia River & Tributaries Study, CRT-63", dated June 1981. During the operating year, Libby operated for storage and releases required for endangered White Sturgeon and Salmon as required by both the U.S. Fish and Wildlife Service and the National Marine Fishery Service Biological Opinions.

Power Deliveries

The Canadian Entitlement to downstream power benefits from Duncan, Arrow and Mica for the 1996-97 operating year had been purchased in 1964 by the Columbia Storage Power Exchange (CSPE). In accordance with the Canadian Entitlement Exchange Agreement dated 13 August 1964, the U.S. Entity delivered capacity and energy to the CSPE participants. The generation at downstream projects in the United States, delivered under the Canadian Entitlement Exchange, was 254 average megawatts from 1 August 1996 through 31 March 1997 and 246 average megawatts from 1 April 1997 through 31 July 1997. Capacity deliveries were up to 486 megawatts from 1 August 1996 through 31 March 1997 and 471 megawatts from 1 April 1997 through 31 July 1997.

In accordance with the Entity Agreement on the Determination of Downstream Power Benefits for Operating Year 1996-97, the Canadian Entity delivered to the U.S. Entity 0.9 average megawatts of annual energy and no dependable capacity during the period 1 August 1996 through 31 March 1997. In accordance with the Entity Agreement on the Determination of Downstream Power Benefits for Operating Year 1997-98, the Canadian Entity delivered to the U.S. Entity 2.8 average megawatts of annual energy and no dependable capacity during the period 1 April 1997 through 31 July 1997. These energy deliveries were required by Section 7 of the August 1964 Canadian Entitlement Purchase Agreement.

Power Operations

The Coordinated System storage level in the AER at the beginning of the 1996-97 operating year was 99.46 percent full which resulted in the System adopting a 1st-year firm load carrying capability (FLCC) from the critical period studies. Due to above average streamflows throughout the year, the system generally operated to Operating Rule Curve (ORC) or flood control for the entire period, producing large amounts of surplus energy. The system storage energy reached 99.09 percent full on 31 July 1997, and the system adopted 1st-year FLCC from the 1997-98 PNCA Final Regulation study.

The following table shows the status of the energy stored in Coordinated System reservoirs at the end of each month in the 1996-97 operating year compared to the ORC (or proportioned draft points were applicable). Normal full Coordinated System reservoir storage energy is approximately 63.7 thousand (KMW-Mo).

END OF PERIOD ENERGY STORAGE

Coordinated System Storage				Canadian Treaty Storage		
Period	ORC/PDP (K-MWmo)	Actual (K-MWmo)	Difference (K-MWmo)	ORC/PDP (K-MWmo)	Actual (K-MWmo)	Difference (K-MWmo)
Aug-96	58.5	58.8	0.3	22.5	22.2	-0.3
Sep-96	55.6	55.4	-0.2	21.8	20.8	-1.0
Oct-96	53.0	51.8	-1.2	20.5	19.4	-1.1
Nov-96	49.3	47.4	-1.9	18.2	17.4	-0.8
Dec-96	43.1	40.7	-2.4	15.0	14.4	-0.6
Jan-97	27.9	29.5	1.6	7.8	8.3	0.5
Feb-97	17.1	19.5	2.4	3.3	4.2	0.9
Mar-97	12.7	15.1	2.4	1.0	2.1	1.1
Apr-97	13.6	16.1	2.5	0.3	2.8	2.5
May-97	38.2	39.9	1.7	6.7	8.5	1.8
Jun-97	58.1	57.5	-0.6	17.8	17.7	-0.1
Jul-97	62.0	62.0	0.0	22.0	22.0	0.0
Aug-97	58.5	57.8	0.7	22.5	21.9	-0.6
Sep-97	55.7	56.2	0.5	21.6	21.4	-0.2

As of 30 September 1996, the sum of Canadian Treaty storage was positioned 202 ksfd below the AER study storage total as per terms of the 1996 Libby-Arrow water transfer agreement. The two Entities agreed to return Treaty storage to the AER study level such that half of the difference (101 ksfd) would be filled during the U.S. Vernita Bar spawning season (October/November), with the other half being filled during the Canadian whitefish spawning season (December).

In early September, the U.S. began flexibility draft at Arrow at a rate of 5 kcfs per day through early October for a total draft below TSR of 188 ksfd. The U.S. obtained the right to flexibility draft in return for Canadian whitefish operations in the previous January. The flexibility draft was returned in February of 1997.

Treaty operations during the period December 1996 through April 1997 were planned to facilitate meeting fisheries objectives in Canada. These objectives covered mountain whitefish and rainbow trout spawning in Canada between Arrow Dam and the border. Due to the record runoff, U.S. Flow Augmentation and Vernita Bar requirements did not require the assistance of Treaty storage.

In January, the Arrow Treaty discharge was reduced from the mid-80's kcfs to 45 kcfs for approximately 14 days to keep mountain whitefish spawning at the lowest practical river levels. The storage resulting from whitefish operations was allocated as follows; 262 ksfd in NTS, 150 ksfd above TSR at Arrow with release in February and March, and 56 ksfd above TSR at Mica with release in late

July. In late January, Arrow Treaty discharges were again reduced for generation limits at Grand Coulee and flood control considerations. The storage above TSR at Arrow increased to 246 ksfd.

During the April through July 1997 period, water was retained in Arrow above its PDP under terms of the 1997 Operating Committee Agreement on the Operation of Treaty Storage for Enhancement of Trout Spawning. By 30 April 1997, the Arrow Treaty elevation was approximately 0.8 Maf above PDP elevation. During the May through July period, this water was released in a manner consistent with Canadian needs for trout spawning and progressive Arrow refill. Considering the record January through July runoff and the unusual hydrologic events, U.S. and Canadian fisheries objectives were satisfied to the extent possible.

Flood Control

The Columbia River Basin reservoir system was operated for flood control once during the winter of 1996-97. Most of the flood contribution came from the Willamette River and lower Columbia River tributaries. Treaty projects' outflows were not reduced to alleviate flooding conditions in the Portland-Vancouver harbor during this high water event because there was sufficient storage available in Grand Coulee to achieve flood control objectives. The peak regulated flow at The Dalles was 321,500 cfs on 5 January 1997 and the peak unregulated flow was 398,000 cfs on 3 January 1997. The observed peak stage at Vancouver, Washington was 22.1 feet, 6.1 feet over flood stage, on 2 January 1997. The unregulated stage for this event would have been 23.9 feet on 4 January 1997.

Flood stage at Vancouver, Washington was exceeded for much of May and June during the spring runoff. Significant flood control was provided by the Treaty projects in the course of regulating the 133 MAF (143% of normal) April - August runoff volume at The Dalles. The observed and unregulated hydrographs for the Columbia River at The Dalles between 1 April 1997 and 31 July 1997 are shown on Chart 14. The unregulated peak flow at The Dalles would have been 896,000 cubic feet per second (cfs) on 7 June 1997 and it was controlled to a maximum of 570,700 cfs on 15 June 1997. The observed peak stage at Vancouver, Washington was 19.0 feet on 4 June 1997 and the unregulated stage would have been 28.4 feet on 8 June 1997.

Chart 15 documents the relative filling of Arrow and Grand Coulee during the principal filling period, and compares the regulation of these two reservoirs to guidelines in the Treaty Flood Control Operating Plan.

Computations of the Initial Controlled Flow (ICF) for system flood control operation were made in accordance with the Treaty Flood Control Operating Plan. Computed Initial Controlled Flows at The Dalles were 487,000 cfs on 1 January 1997, 499,000 cfs on 1 February, 477,000 cfs on 1 March, 494,000†cfs on 1 April, and 518,000 cfs on 1 May. As mentioned earlier, the observed peak flow at The Dalles was 570,700 cfs. Data for the 1 May ICF computation are given in Table 6.

Table 1
Unregulated Runoff Volume Forecasts
Million of Acre-Feet
1997

Forecast Date - 1st of	Duncan Most Probable 1 April - 31 August	Arrow Most Probable 1 April - 31 August	Mica Most Probable 1 April - 31 August	Libby Most Probable 1 April - 31 August	Columbia River at The Dalles, Oregon Most Probable 1 April - 31 August
January	2.1	23.7	11.8	7.1	121.0
February	2.3	25.2	12.5	7.4	125.0
March	2.2	25.2	12.4	7.0	121.0
April	2.2	26.1	12.9	7.6	125.0
May	2.3	26.6	13.0	7.7	130.0
June	2.3	26.2	12.6	7.8	136.0
Actual	2.4	26.6	12.5	7.9	133.1

NOTE: These data were used in actual operations. Subsequent revisions have been made in some cases.

TABLE 2
1997 Variable Refill Curve
Mica Reservoir

		INITI	JAN 1	FEB 1	MAR	APR 1	MAY	JUN 1
PROBABLE DATE-31JULY INFLOW,KAF			9733.0	10334.	9990.9	10157.	9804.4	7787.2
PROBABLE DATE-31JULY INFLOW,KSFD			4907.0	5210.0	5037.0	5121.0	4943.0	3926
95% FORECAST ERROR FOR DATE, KSFD			822.5	518.2	450.7	429.3	389.9	389.9
95% CONF.DATE-31JULY	1/		4084.7	4691.4	4586.7	4691.5	4553.2	3536.1
ASSUMED FEB1-JUL31 INFLOW,% OF			100.0					
ASSUMED FEB1-JUL31	2/		4084.7					
FEB MINIMUM FLOW	3/		3000.0					
MIN FEB1-JUL31	4/		970.0					
MIN JAN31 RESERVOIR	5/		414.5					
MIN JAN31 RESERVOIR	6/		2404.3					
JAN31 ECC,FT.	7/		2417.9					
BASE ECC, FT		2452.9						
LOWER LIMIT,FT		2417.9						
ASSUMED MAR1-JUL31 INFLOW,% OF			97.8	97.8				
ASSUMED MAR1-JUL31	2/		3994.8	4588.2				
MAR MINIMUM FLOW	3/		3000.0	3000.0				
MIN MAR1-JUL31	4/		886.0	886.0				
MIN FEB28 RESERVOIR	5/		420.4	-173.0				
MIN FEB28 RESERVOIR	6/		2404.4	2389.6				
FEB28 ECC,FT.	7/		2404.4	2403.0				
BASE ECC,FT		2443.0						
LOWER LIMIT,FT		2403.0						
ASSUMED APR1-JUL31 INFLOW,% OF			95.3	95.3	97.5			
ASSUMED APR1-JUL31	2/		3892.7	4470.9	4472.0			
APR MINIMUM FLOW	3/		3000.0	3000.0	3000.0			
MIN APR1-JUL31	4/		793.0	793.0	793.0			
MIN MAR31 RESERVOIR	5/		429.5	-148.7	-149.8			
MIN MAR31 RESERVOIR	6/		2404.7	2390.3	2390.2			
MAR31 ECC,FT.	7/		2404.7	2394.5	2394.5			
BASE ECC,FT		2432.0						
LOWER LIMIT,FT		2394.5						
ASSUMED MAY1-JUL31 INFLOW,% OF			90.4	90.4	92.5	94.8		
ASSUMED MAY1-JUL31	2/		3692.6	4241.0	4242.7	4447.5		
MAY MINIMUM FLOW	3/		3000.0	3000.0	3000.0	3000.0		
MIN MAY1-JUL31	4/		703.0	703.0	703.0	703.0		
MIN APR30 RESERVOIR	5/		539.6	-8.8	-10.5	-215.3		
MIN APR30 RESERVOIR	6/		2407.3	2394.1	2394.1	2394.1		
APR30 ECC,FT.	7/		2407.3	2394.1	2394.1	2394.1		
BASE ECC,FT		2421.5						
ASSUMED JUN1-JUL31 INFLOW,% OF			72.5	72.5	74.2	76.1	80.3	
ASSUMED JUN1-JUL31	2/		2961.4	3401.3	3403.3	3570.2	3656.2	
JUN MINIMUM FLOW	3/		10000.	10000.	10000.	10000.	10000.	
MIN JUN1-JUL31	4/		610.0	610.0	610.0	610.0	610.0	
MIN MAY31 RESERVOIR	5/		1177.8	737.9	735.9	569.0	483.0	
MIN MAY31 RESERVOIR	6/		2421.9	2411.9	2411.9	2408.0	2405.9	
MAY31 ECC,FT.	7/		2421.9	2411.9	2411.9	2408.0	2405.9	
BASE ECC,FT		2425.8						
ASSUMED JUL1-JUL31 INFLOW,% OF VOL.			35.9	35.9	36.7	37.7	39.7	49.5
ASSUMED JUL1-JUL31	2/		1466.4	1684.2	1683.3	1768.7	1807.6	1750.4
JUL MINIMUM FLOW	3/		10000.	10000.	10000.	10000.	10000.	10000.
MIN JUL1-JUL31	4/		310.0	310.0	310.0	310.0	310.0	310.0
MIN JUN30 RESERVOIR	5/		2372.8	2155.0	2155.9	2070.5	2031.6	2088.8
MIN JUN30 RESERVOIR	6/		2447.4	2442.9	2442.9	2441.1	2440.3	2441.5
JUN30 ECC,FT.	7/		2447.4	2442.9	2442.9	2441.1	2440.3	2441.5
BASE ECC,FT		2449.8						
JUL 31 ECC, FT			2470.1	2470.1	2470.1	2470.1	2470.1	2470.1

** FORECAST START DATE IS 1FEB OR LATER. OBSERVED INFLOW FROM 1JAN-DATE IS
1/ PROBABLE INFLOW MINUS 95% ERROR..... 2/PRECEEDING LINE TIMES 1/.
3/ POWER DISCHARGE REQUIREMENTS. 4/ CUMULATIVE MINIMUM OUTFLOW FROM 3/,DATE TO
5/ FULL CONTENT (3529.2 KSFD) PLUS 4/ MINUS /2. 6/ ELEV FROM 5/, INTERP FROM STORAGE
7/ LOWER OF ELEV. FROM 6/ OR BASE ECC DETERMINED PRIOR TO YEAR (INTIAL),BUT NOT LESS

TABLE 3
1997 Variable Refill Curve
Arrow Reservoir

		INITI	JAN 1 Total	FEB 1 Total	MAR Total	APR 1 Total	MAY Total	JUN 1 Total
PROBABLE DATE-31JULY INFLOW,KAF			20715.	22185.	21519.	21626.	20588.	15155.
PROBABLE DATE-31JULY INFLOW,KSFD			1044.0	1185.0	10849.	10903.	1038.0	7641
95% FORECAST ERROR FOR DATE,IN			1682.8	1093.9	939.3	794.5	672.8	672.8
95% CONF.DATE-31JULY	1/		8761.6	10091.	9909.4	10108.	9707.2	6968.2
ASSUMED FEB1-JUL31 INFLOW,% OF			100.0					
ASSUMED FEB1-JUL31	2/		8761.6					
MIN FEB1-JUL31	3/		2430.0					
UPSTREAM REFILL,KSFD	4/		2531.2					
MIN FEB28 RESERVOIR	5/		0.0					
MIN JAN31 RESERVOIR	6/		1377.9					
JAN31 ECC,FT.	7/		1410.0					
BASE ECC, FT		1401.9						
LOWER LIMIT, FT		1410.0						
ASSUMED MAR1-JUL31 INFLOW,% OF			97.5	97.5				
ASSUMED MAR1-JUL31	2/		8542.5	9838.9				
MIN MAR1-JUL31	3/		2290.0	2290.0				
UPSTREAM REFILL,KSFD	4/		3108.8	3168.6				
MIN FEB28 RESERVOIR	5/		435.9	0.0				
MIN FEB28 RESERVOIR	6/		1388.1	1377.9				
FEB28 ECC,FT.	7/		1393.9	1393.9				
BASE ECC, FT		1394.2						
LOWER LIMIT, FT		1393.9						
ASSUMED APR1-JUL31 INFLOW,% OF			94.5	94.5	97.0			
ASSUMED APR1-JUL31	2/		8279.7	9536.2	9612.1			
MIN APR1-JUL31	3/		2135.0	2135.0	2135.0			
UPSTREAM REFILL,KSFD	4/		3099.7	3516.7	3516.7			
MIN MAR31 RESERVOIR	5/		534.6	0.0	0.0			
MIN MAR31 RESERVOIR	6/		1390.2	1377.9	1377.9			
MAR31 ECC,FT.	7/		1390.2	1379.5	1379.5			
BASE ECC,FT		1402.4						
LOWER LIMIT, FT		1379.5						
ASSUMED MAY1-JUL31 INFLOW,% OF			88.0	88.0	90.3	93.0		
ASSUMED MAY1-JUL31	2/		7710.2	8880.2	8948.2	9401.2		
MIN MAY1-JUL31	3/		1985.0	1985.0	1985.0	1985.0		
UPSTREAM REFILL,KSFD	4/		2989.6	3529.2	3529.2	3529.2		
MIN APR30 RESERVOIR	5/		844.0	213.6	145.6	0.0		
MIN APR30 RESERVOIR	6/		1396.6	1383.1	1381.5	1377.9		
APR30 ECC,FT.	7/		1396.6	1383.1	1381.5	1377.9		
BASE ECC, FT		1406.2						
ASSUMED JUN1-JUL31 INFLOW,% OF			66.5	66.5	68.2	70.3	75.5	
ASSUMED JUN1-JUL31	2/		5826.4	6710.6	6758.2	7106.5	7328.9	
MIN JUN1-JUL31	3/		1830.0	1830.0	1830.0	1830.0	1830.0	
UPSTREAM REFILL,KSFD	4/		2351.4	2791.3	2793.3	2960.2	3046.2	
MIN MAY31 RESERVOIR	5/		1934.6	1490.3	1444.7	1263.3	1126.9	
MIN MAY31 RESERVOIR	6/		1417.1	1409.1	1408.3	1404.8	1402.2	
MAY31 ECC,FT.	7/		1417.1	1409.1	1408.3	1404.8	1402.2	
BASE ECC,FT		1418.6						
ASSUMED JUL1-JUL31 INFLOW,% OF VOL.			30.8	30.8	31.5	32.5	35.0	46.3
ASSUMED JUL1-JUL31	2/		2698.6	3108.1	3121.5	3285.4	3397.5	3226.3
MIN JUL1-JUL31	3/		930.0	930.0	930.0	930.0	930.0	930.0
UPSTREAM REFILL,KSFD	4/		1156.4	1374.2	1373.3	1458.7	1497.6	1440.4
MIN JUN30 RESERVOIR	5/		2967.4	2775.7	2761.4	2682.9	2609.7	2723.7
MIN JUN30 RESERVOIR	6/		1434.5	1434.4	1431.1	1429.8	1428.6	1430.5
JUN30 ECC,FT.	7/		1434.5	1434.4	1431.1	1429.8	1428.6	1430.5
BASE ECC,FT		1436.1						
JUL 31 ECC, FT			1444.0	1444.0	1444.0	1444.0	1444.0	1444.0

** FORECAST START DATE IS 1FEB OR LATER. OBSERVED INFLOW FROM 1JAN-DATE IS
1/ PROBABLE INFLOW MINUS 95% ERROR. ..... 2/PRECEEDING LINE TIMES 1/.
3/ CUMMULATIVE MINIMUM OUTFLOW FROM DATE TO JULY, USING POWER DISCHARGE
4/ UPSTREAM REFILL REQUIREMENT. 5/ FULL CONTENT(3579.6 KSFD) MINUS 2/ PLUS 3/ PLUS /4.
6/ ELEV. FROM 5/, INTERP. FROM STORAGE CONTENT TABLE
7/ LOWER OF ELEV. FROM 6/ OR ELEV DETERMINED PRIOR TO YEAR (INTIAL),BUT NOT LESS

TABLE 4
1996 Variable Refill Curve
Duncan Reservoir

		INITI	JAN 1	FEB 1	MAR	APR 1	MAY	JUN 1
PROBABLE DATE-31JULY INFLOW,KAF			1783.2	1987.5	1852.6	1846.6	1793.1	1344.8
PROBABLE DATE-31JULY INFLOW,KSFD			899.0	1002.0	934.00	931.0	904.0	678.0
95% FORECAST ERROR FOR DATE,IN			135.9	117.0	106.6	94.9	92.0	89.0
95% CONF.DATE-31JULY	1/		763.1	884.8	827.7	836.4	812.4	588.6
ASSUMED FEB1-JUL31 INFLOW,% OF			100.0					
ASSUMED FEB1-JUL31	2/		763.1					
FEB MINIMUM FLOW	3/		100.0					
MIN FEB1-JUL31	4/		18.1					
MIN JAN31 RESERVOIR	5/		0.0					
MIN JAN31 RESERVOIR	6/		1794.1					
JAN31 ECC,FT	7/		1794.5					
BASE ECC,FT		1851.0						
LOWER LIMIT, FT		1794.5						
ASSUMED MAR1-JUL31 INFLOW,% OF			97.9	97.9				
ASSUMED MAR1-JUL31	2/		747.1	866.3				
MAR MINIMUM FLOW	3/		100.0	100.0				
MIN MAR1-JUL31	4/		15.3	15.3				
MIN FEB28 RESERVOIR	5/		0.0	0.0				
MIN FEB28 RESERVOIR	6/		1794.1	1794.1				
FEB28 ECC,FT.	7/		1794.2	1794.2				
BASE ECC,FT		1835.9						
LOWER LIMIT, FT		1794.2						
ASSUMED APR1-JUL31 INFLOW,% OF			95.4	95.4	97.5			
ASSUMED APR1-JUL31	2/		728.0	844.1	807.0			
APR MINIMUM FLOW	3/		100.0	100.0	100.0			
MIN APR1-JUL31	4/		12.2	12.2	12.2			
MIN MAR31 RESERVOIR	5/		0.0	0.0	0.0			
MIN MAR31 RESERVOIR	6/		1794.8	1794.1	1794.1			
MAR31 ECC,FT.	7/		1794.8	1794.2	1794.2			
BASE ECC,FT		1836.5						
LOWER LIMIT, FT		1794.2						
ASSUMED MAY1-JUL31 INFLOW,% OF			89.5	89.5	91.4	93.8		
ASSUMED MAY1-JUL31	2/		683.0	791.9	756.5	784.5		
MAY MINIMUM FLOW	3/		100.0	100.0	100.0	100.0		
MIN MAY1-JUL31	4/		9.2	9.2	9.2	9.2		
MIN APR30 RESERVOIR	5/		32.0	0.0	0.0	0.0		
MIN APR30 RESERVOIR	6/		1801.4	1794.1	1794.1	1794.1		
APR30 ECC,FT.	7/		1801.4	1794.1	1794.1	1794.1		
BASE ECC,FT		1837.7						
ASSUMED JUN1-JUL31 INFLOW,% OF			68.7	68.7	70.1	71.9	76.7	
ASSUMED JUN1-JUL31	2/		524.3	607.9	580.2	601.4	623.1	
JUN MINIMUM FLOW	3/		100.0	100.0	100.0	100.0	100.0	
MIN JUN1-JUL31	4/		6.1	6.1	6.1	6.1	6.1	
MIN MAY31 RESERVOIR	5/		187.6	104.0	131.7	110.5	88.8	
MIN MAY31 RESERVOIR	6/		1827.2	1814.3	1818.8	1815.4	1811.8	
MAY31 ECC,FT.	7/		1827.2	1814.3	1818.8	1815.4	1811.8	
BASE ECC,FT		1854.7						
ASSUMED JUL1-JUL31 INFLOW,% OF VOL.			32.1	32.1	32.8	33.6	35.9	46.9
ASSUMED JUL1-JUL31	2/		245.0	284.0	271.5	281.0	291.7	276.1
JUL MINIMUM FLOW	3/		100.0	100.0	100.0	100.0	100.0	100.0
MIN JUL1-JUL31	4/		3.1	3.1	3.1	3.1	3.1	3.1
MIN JUN30 RESERVOIR	5/		463.9	424.9	437.4	427.9	417.2	432.8
MIN JUN30 RESERVOIR	6/		1863.7	1858.9	1860.5	1859.3	1858.0	1859.9
JUN30 ECC,FT.	7/		1863.7	1858.9	1860.5	1859.3	1858.0	1859.9
BASE ECC,FT		1876.6						
JUL 31 ECC, FT.....			1892.0	1892.0	1892.0	1892.0	1892.0	1892.0

** FORECAST START DATE IS 1FEB OR LATER. OBSERVED INFLOW FROM 1JAN-DATE IS
1/ PROBABLE INFLOW MINUS 95% ERROR. ..... 2/PRECEEDING LINE TIMES 1/
3/ POWER DISCHARGE REQUIREMENTS ... 4/ CUMULATIVE MINIMUM OUTFLOW FROM 3/,DATE
5/ FULL CONTENT (705.8 KSFD) PLUS 4/ MINUS /2. 6/ ELEV FROM 5/, INTERP FROM STORAGE
7/ LOWER OF ELEV. FROM 6/ OR BASE ECC DETERMINED PRIOR TO YEAR (INTIAL),BUT NOT LESS

TABLE 5
1997 Variable Refill Curve
Libby Reservoir

		INITI	JAN 1	FEB 1	MAR	APR 1	MAY	JUN 1
PROBABLE DATE-31JULY INFLOW,KAF			7040.0	7628.0	7495.0	8530.0	9193.0	11655.
PROBABLE DATE-31JULY INFLOW,KSFD			3549.3	3845.8	3778.7	4300.5	4634.8	5876.1
OBSERVED JAN1-DATE INFLOW, IN KSFD			886.8	606.4	552.5	533.4	474.5	367.5
95% FORECAST ERROR FOR DATE, KSFD			0.0	134.6	231.4	408.4	717.4	1878.5
95% CONF.DATE-31JULY	1/		2662.6	3104.8	2994.8	3358.8	3442.9	3630.1
ASSUMED FEB1-JUL31 INFLOW,% OF VOL.			97.0					
ASSUMED FEB1-JUL31	2/		2581.6					
FEB MINIMUM FLOW	3/		4000.0					
MIN FEB1-JUL31 OUTFLOW,KSFD	4/		907.0					
MIN JAN31 RESERVOIR	5/		835.9					
MIN JAN31 RESERVOIR	6/		2367.5					
JAN31 ECC,FT.	7/		2367.5					
BASE ECC,FT		2418.2						
LOWER LIMIT,FT		2288.6						
ASSUMED MAR1-JUL31 INFLOW,% OF			94.2	97.1				
ASSUMED MAR1-JUL31	2/		2507.6	3016.0				
MAR MINIMUM FLOW	3/		4000.0	4000.0				
MIN MAR1-JUL31	4/		795.0	795.0				
MIN FEB28 RESERVOIR	5/		797.9	289.5				
MIN FEB28 RESERVOIR	6/		2364.6	2320.2				
FEB28 ECC,FT.	7/		2364.6	2320.2				
BASE ECC,FT		2415.5						
LOWER LIMIT,FT		2287.0						
ASSUMED APR1-JUL31 INFLOW,% OF VOL.			90.8	93.7	96.4			
ASSUMED APR1-JUL31	2/		2417.9	2907.9	2887.6			
APR MINIMUM FLOW	3/		4000.0	4000.0	4000.0			
MIN APR1-JUL31	4/		671.0	671.0	671.0			
MIN MAR31 RESERVOIR	5/		763.6	273.6	293.9			
MIN MAR31 RESERVOIR	6/		2362.0	2318.6	2320.7			
MAR31 ECC,FT.	7/		2362.0	2318.6	2320.7			
BASE ECC,FT		2412.7						
LOWER LIMIT,FT		2287.0						
ASSUMED MAY1-JUL31 INFLOW,% OF			82.7	85.3	87.8	91.1		
ASSUMED MAY1-JUL31	2/		2201.9	2648.0	2629.4	3058.8		
MAY MINIMUM FLOW	3/		4000.0	4000.0	4000.0	4000.0		
MIN MAY1-JUL31	4/		551.0	551.0	551.0	551.0		
MIN APR30 RESERVOIR	5/		859.6	413.4	432.1	2.7		
MIN APR30 RESERVOIR	6/		2369.3	2332.2	2333.9	2287.3		
APR30 ECC,FT.	7/		2369.3	2332.2	2333.9	2287.3		
BASE ECC,FT		2411.8						
ASSUMED JUN1-JUL31 INFLOW,% OF VOL.			55.3	57.0	58.7	60.9	66.9	
ASSUMED JUN1-JUL31	2/		1471.9	1770.3	1757.9	2044.8	2301.5	
JUN MINIMUM FLOW	3/		7000.0	7000.0	7000.0	7000.0	7000.0	
MIN JUN1-JUL31 OUTFLOW,KSFD	4/		427.0	427.0	427.0	427.0	427.0	
MIN MAY31 RESERVOIR	5/		1465.6	1167.2	1179.5	892.7	636.0	
MIN MAY31 RESERVOIR	6/		2409.0	2390.9	2391.7	2371.8	2351.7	
MAY31 ECC,FT.	7/		2409.0	2390.9	2391.7	2371.8	2351.7	
BASE ECC,FT		2434.7						
ASSUMED JUL1-JUL31 INFLOW,% OF VOL.			19.6	20.2	20.8	21.6	23.7	35.5
ASSUMED JUL1-JUL31	2/		521.9	627.8	623.2	724.8	816.0	1286.9
JUL MINIMUM FLOW	3/		7000.0	7000.0	7000.0	7000.0	7000.0	7000.0
MIN JUL1-JUL31 OUTFLOW,KSFD	4/		217.0	217.0	217.0	217.0	217.0	217.0
MIN JUN30 RESERVOIR	5/		2205.6	2099.7	2104.3	2002.7	1911.5	1440.6
MIN JUN30 RESERVOIR	6/		2445.6	2440.8	2441.0	2436.2	2431.9	2407.5
JUN30 ECC,FT.	7/		2445.6	2440.8	2441.0	2436.2	2431.9	2407.5
BASE ECC,FT		2459.0						
JUL 31 ECC, FT			2459.0	2459.0	2459.0	2459.0	2459.0	2459.0
JAN1-JUL31 FORECAST,-	8/		120.0	145	141	153	150	153

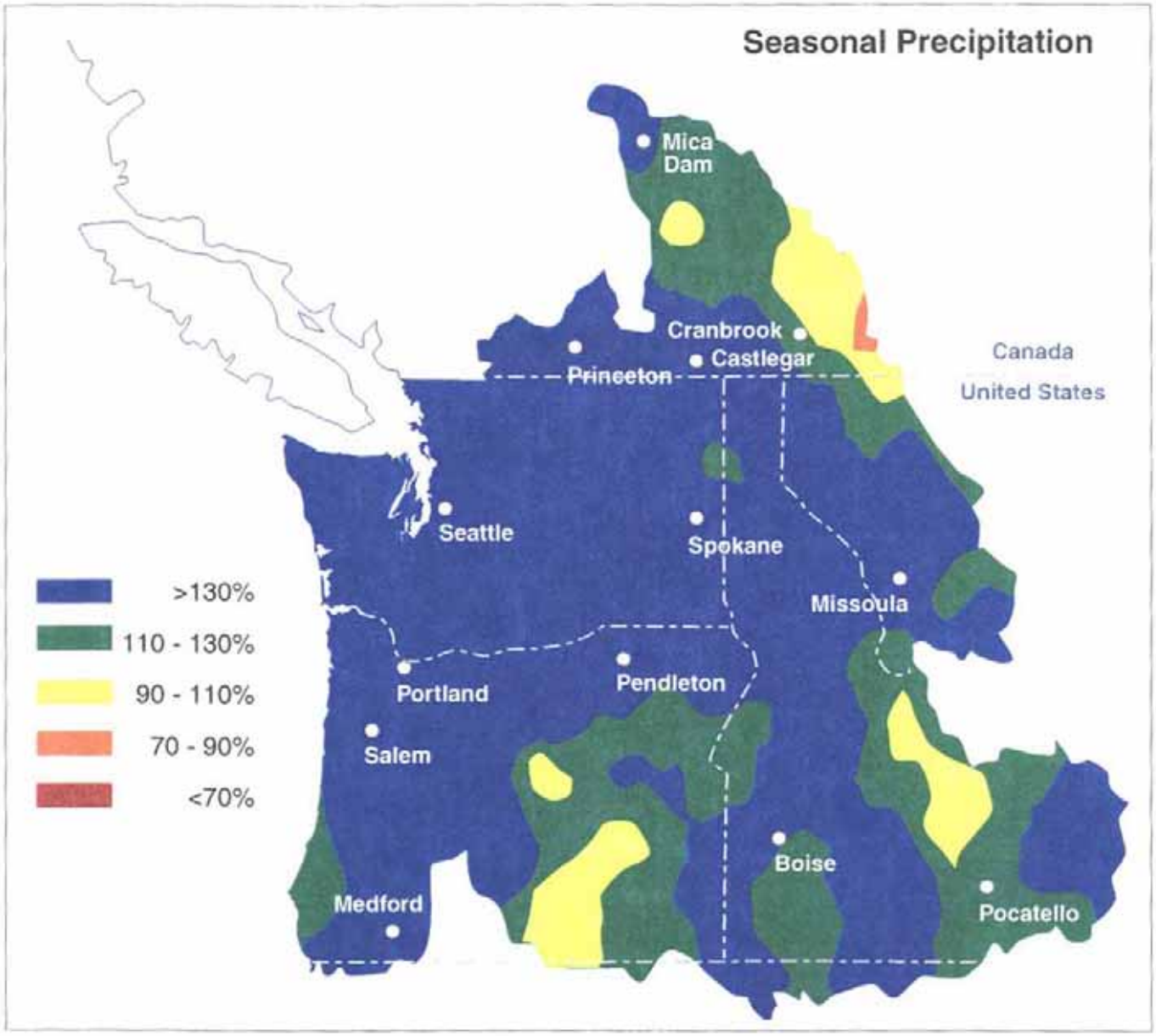
1/ PROBABLE INFLOW MINUS (95% ERROR MINUS OBSERVED INFLOW. 2/PRECEEDING LINE
3/ POWER DISCHARGE REQUIREMENTS. 4/ CUMULATIVE MINIMUM OUTFLOW FROM 3/,DATE TO
5/ FULL CONTENT (2510.5 KSFD) PLUS 4/ MINUS /2. 6/ ELEV FROM 5/. INTERP FROM STORAGE
7/ LOWER OF ELEV. FROM 6/ OR BASE ECC DETERMINED PRIOR TO YEAR (INTIAL),BUT NOT LESS
8/ USED TO CALCULATE THE POWER DISCHARGE REQUIREMENTS FOR 3/.

Table 6

Computation of Initial Controlled Flow
Columbia River at The Dalles
1 May 1997

1 May Forecast of May-August Unregulated Runoff Volume, Maf		111.0
Less Estimated Depletions, Maf		1.5
Less Upstream Storage Corrections, Maf		31.136
MICA	7.979	
ARROW	5.000	
DUNCAN	1.379	
LIBBY	4.980	
LIBBY + DUNCAN UNDER DRAFT	-1.077	
HUNGRY HORSE	2.093	
FLATHEAD LAKE	0.500	
NOXON RAPIDS	0.000	
PEND OREILLE LAKE	0.458	
GRAND COULEE	5.052	
BROWNLEE	0.950	
DWORSHAK	1.922	
JOHN DAY	0.400	
TOTAL	29.636	31.136
Forecast of Adjusted Residual Runoff Volume, Maf		79.864
Computed Initial Controlled Flow from Chart 1 of Flood Control Operating Plan, 1,000 cfs		518

Chart 1
Seasonal Precipitation
Columbia River Basin
October 1996 - September 1997
Percent of 1961 - 1985 Average



Information prepared by
NATIONAL WEATHER SERVICE
Northwest River Forecast Center
Portland, Oregon

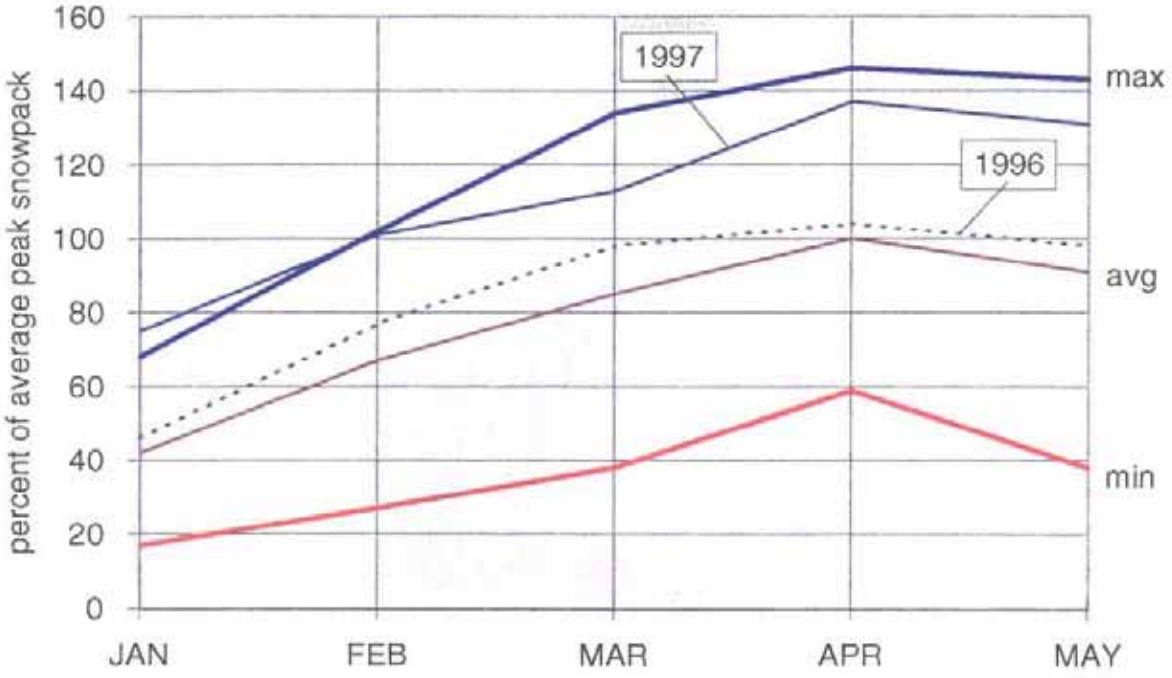
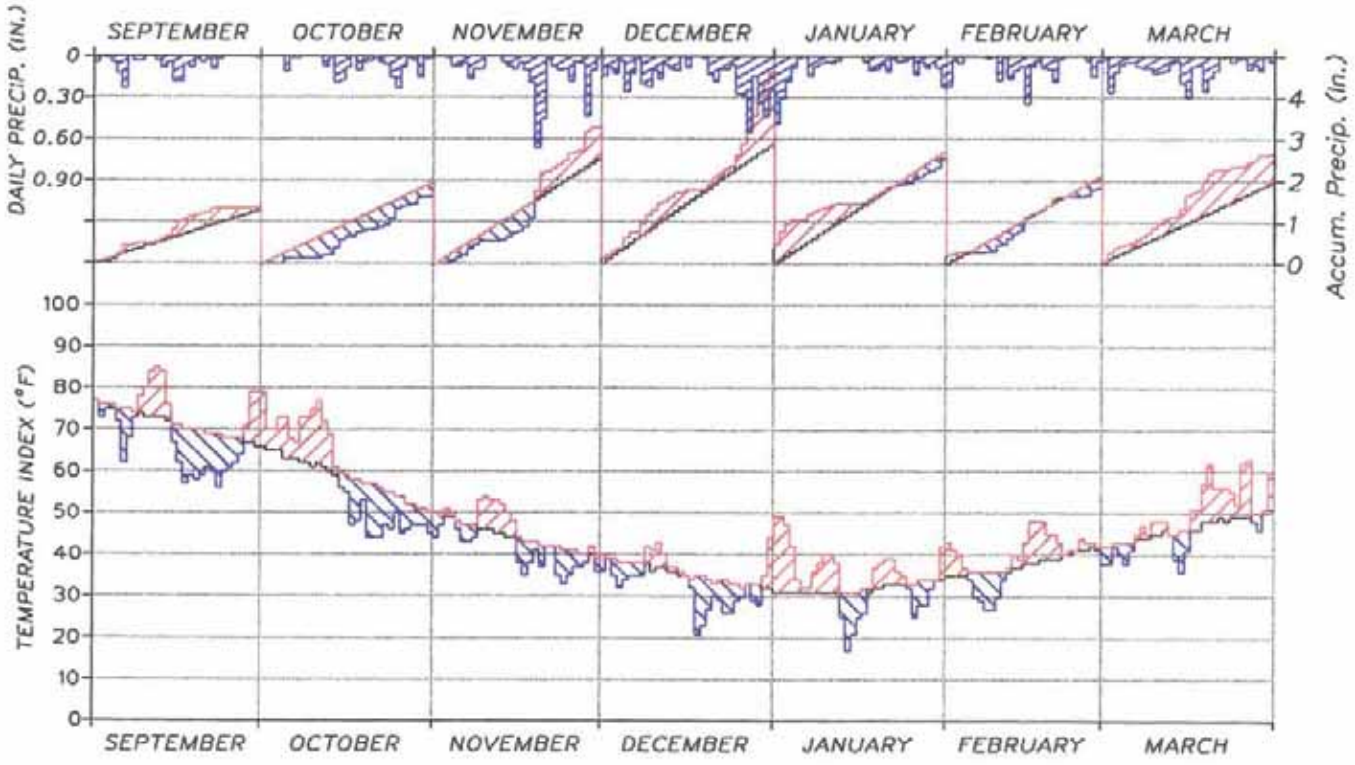
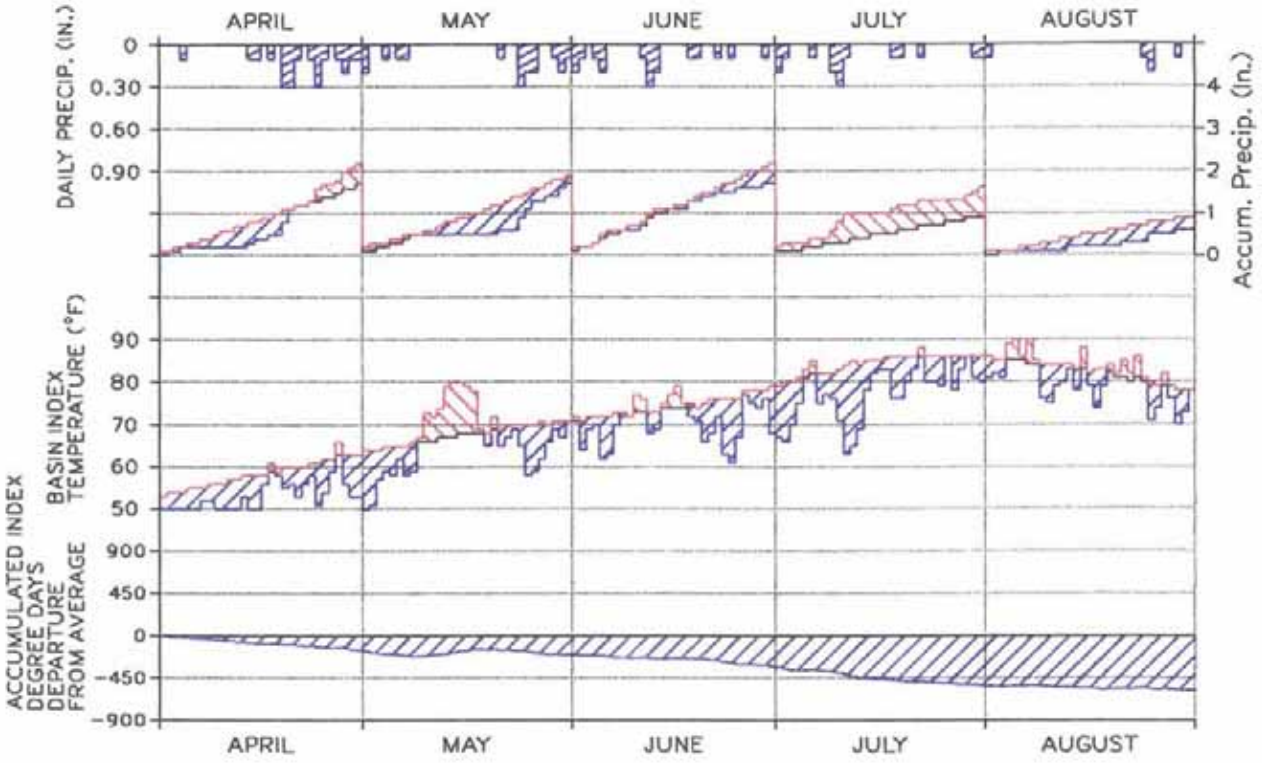


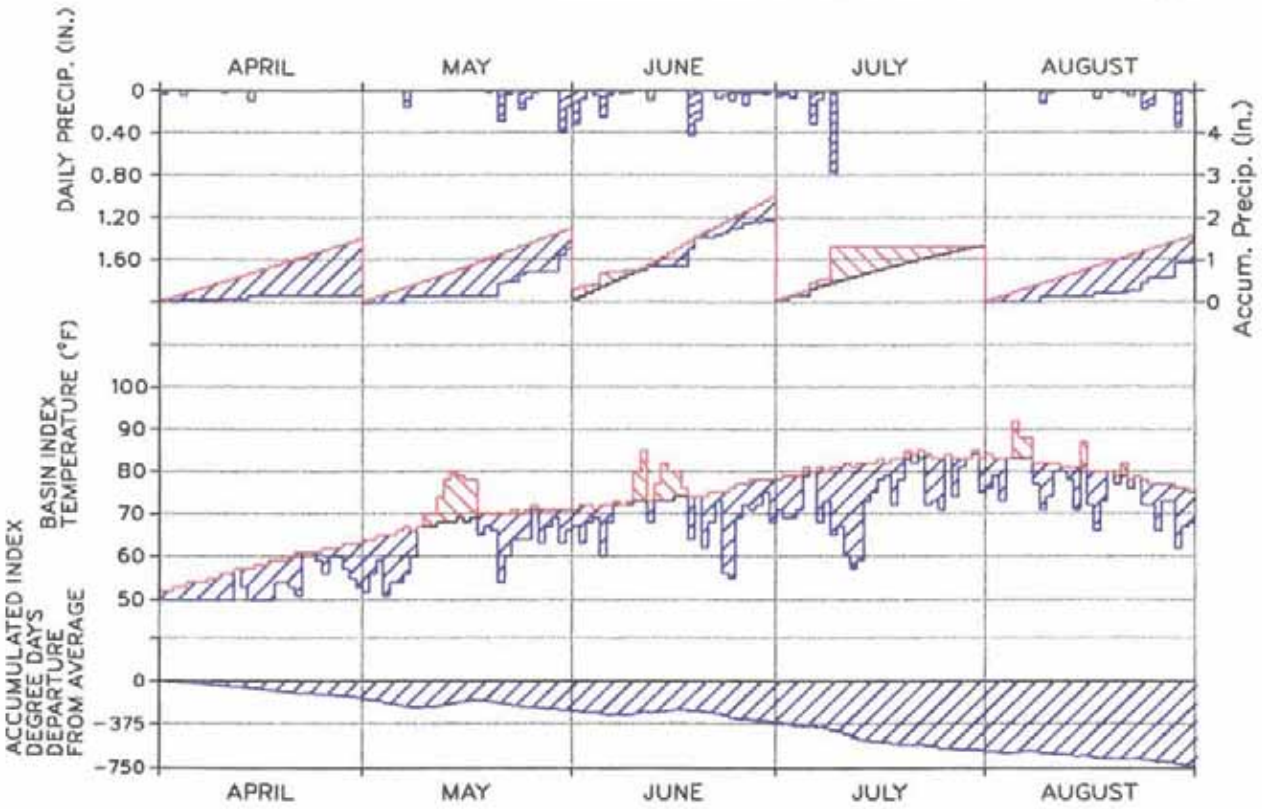
Chart 2
Columbia Basin Snowpack



WINTER SEASON CHART 3
TEMPERATURE AND PRECIPITION INDEX 1996–1997
COLUMBIA RIVER BASIN ABOVE THE DALLES, OR

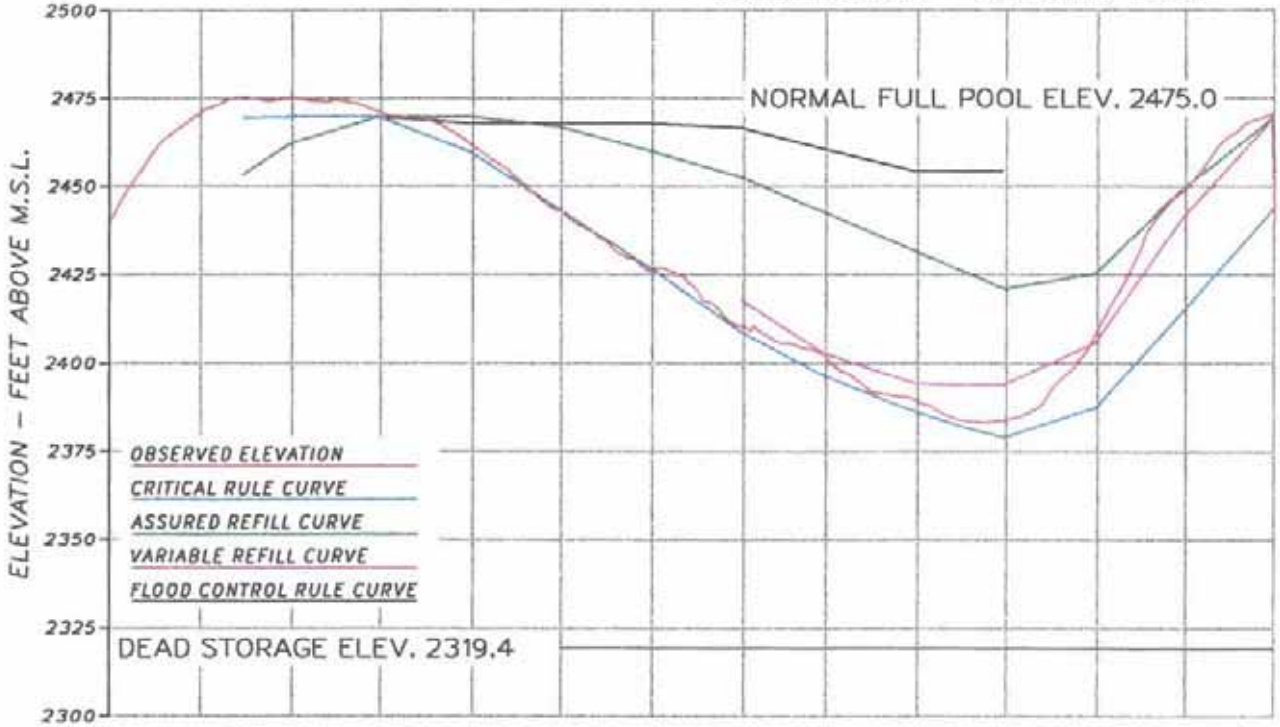


1997 SNOWMELT SEASON CHART 4
TEMPERATURE AND PRECIPITATION INDEX
COLUMBIA RIVER BASIN ABOVE THE DALLES, OR



1997 SNOWMELT SEASON Chart 5
TEMPERATURE AND PRECIPITATION INDEX
COLUMBIA RIVER BASIN IN CANADA

CHART 6
REGULATION OF MICA
1 JULY 1996 – 31 JULY 1997



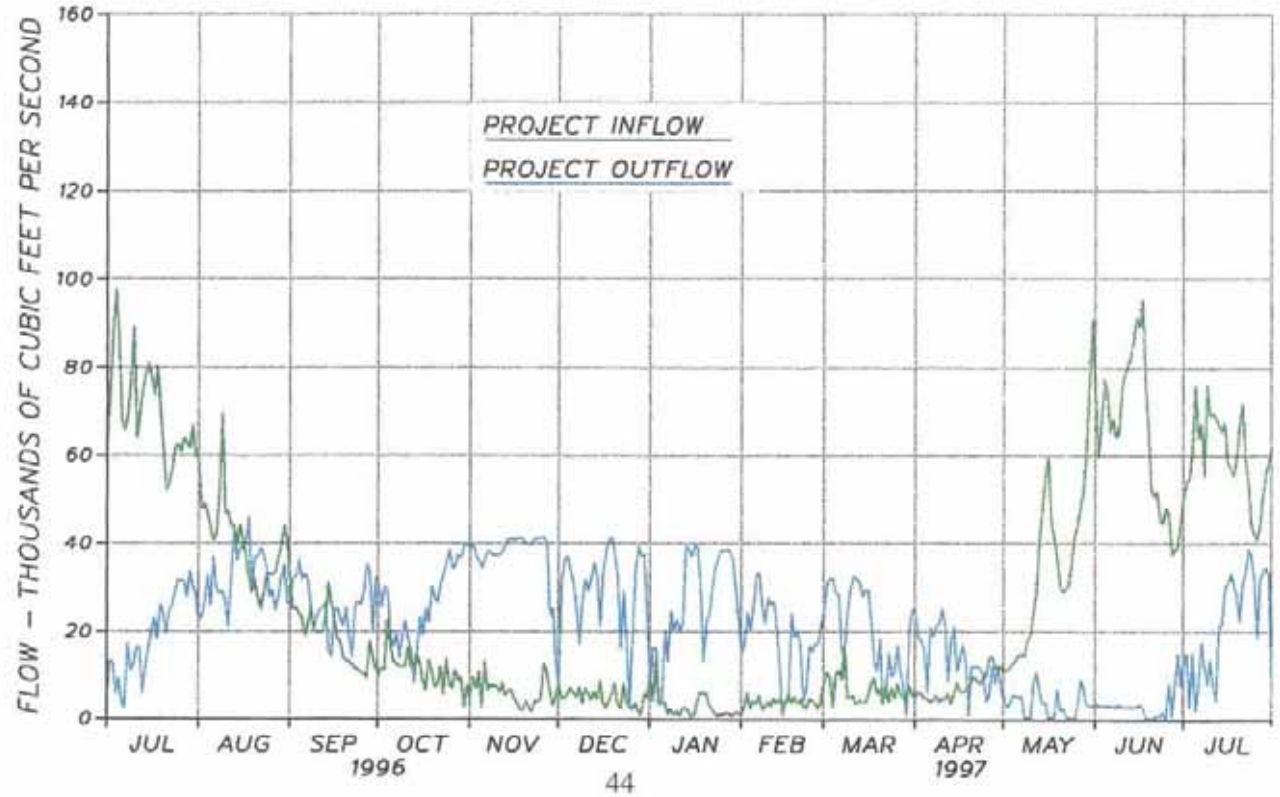
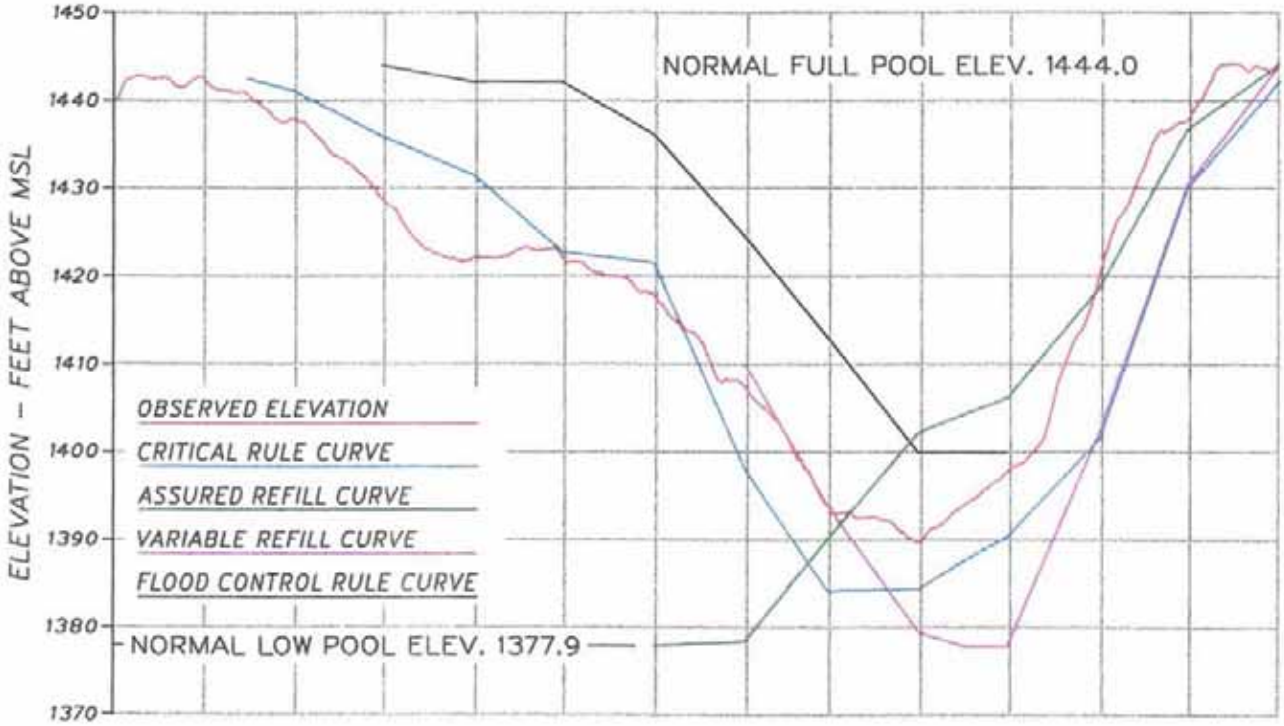


CHART 7
REGULATION OF ARROW
1 JULY 1996 – 31 JULY 1997



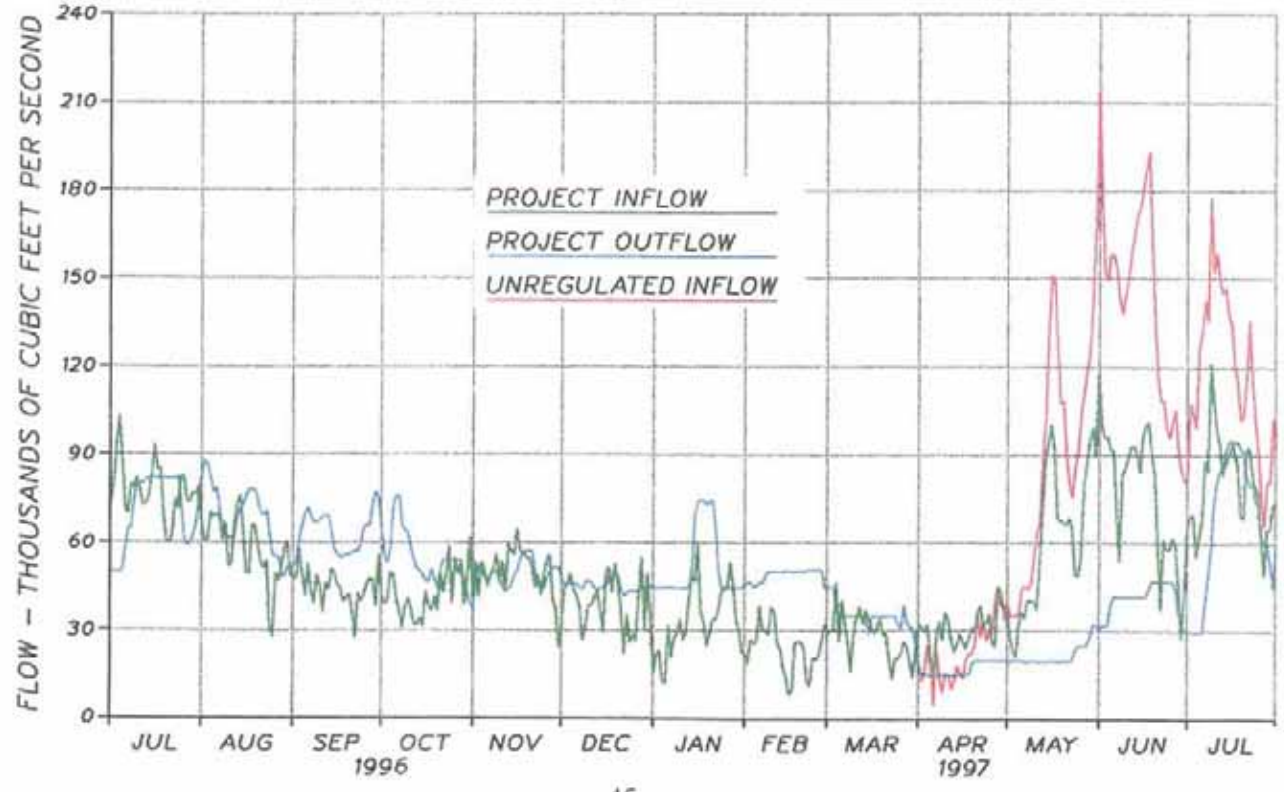
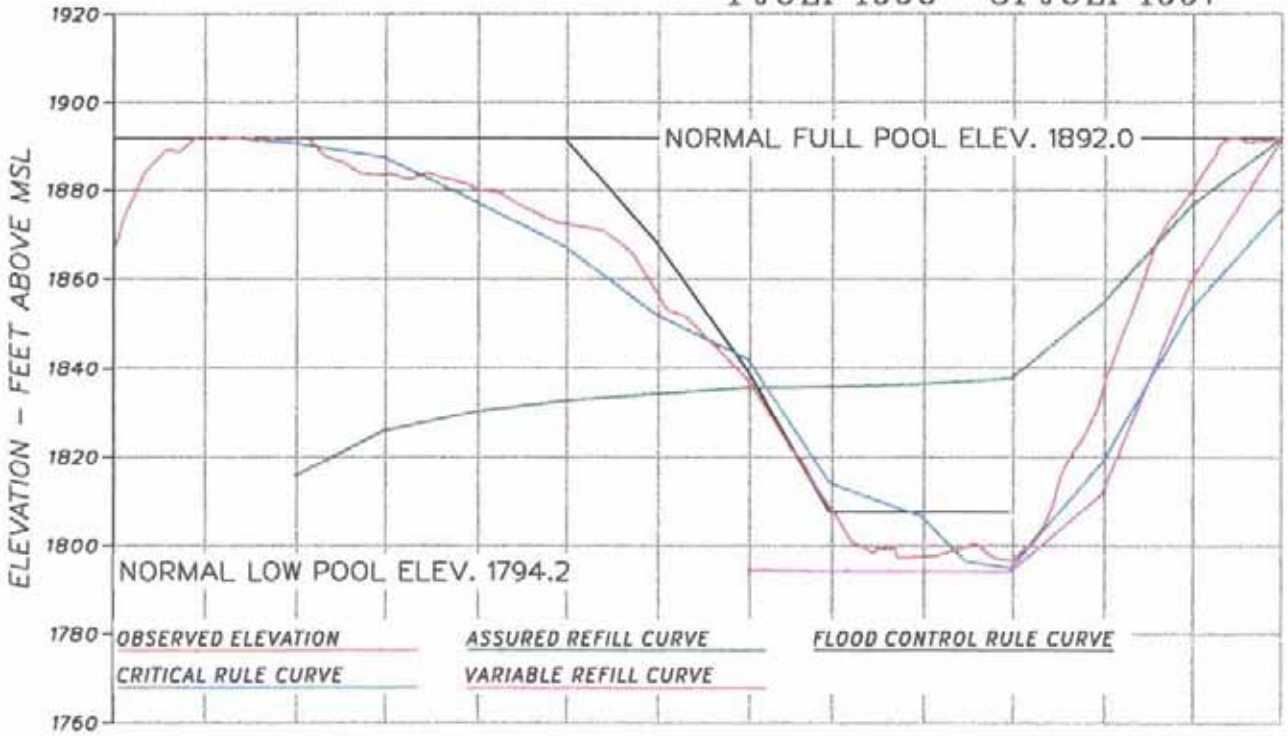


CHART 8
REGULATION OF DUNCAN
1 JULY 1996 – 31 JULY 1997



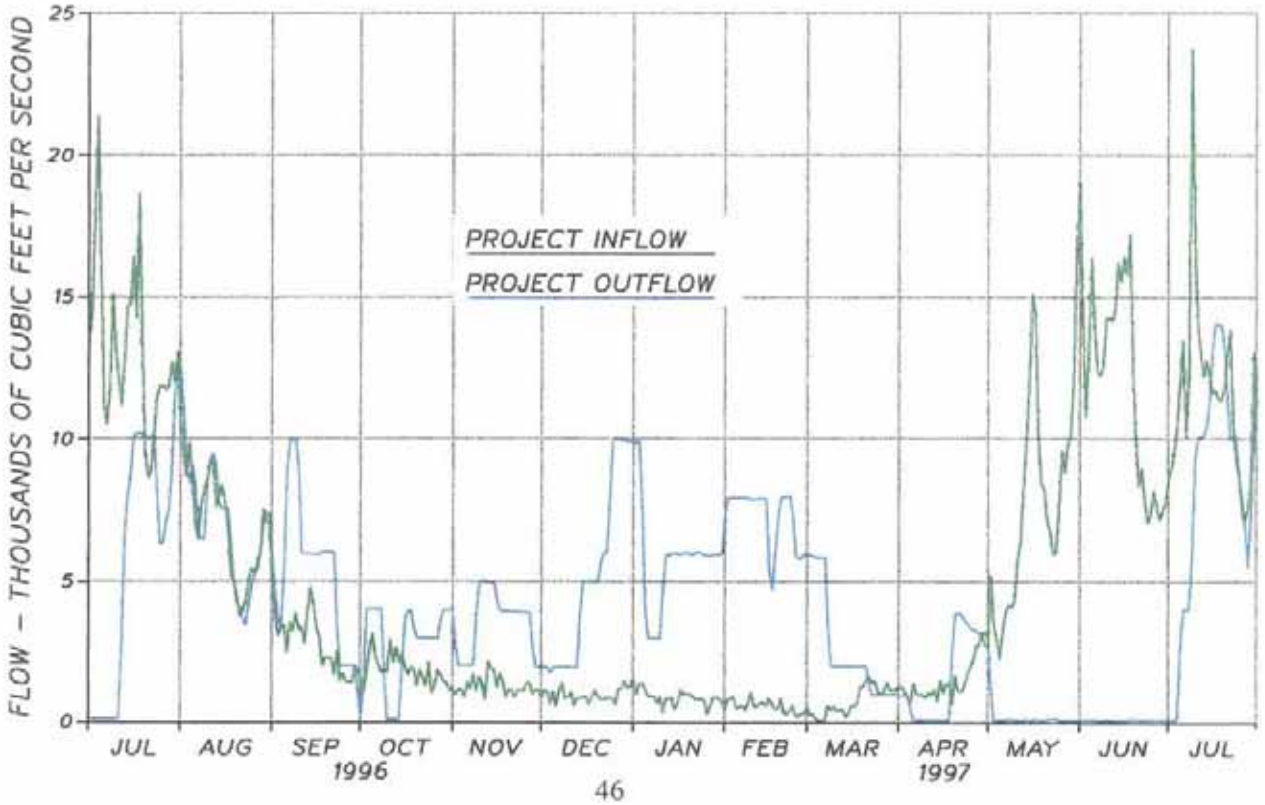
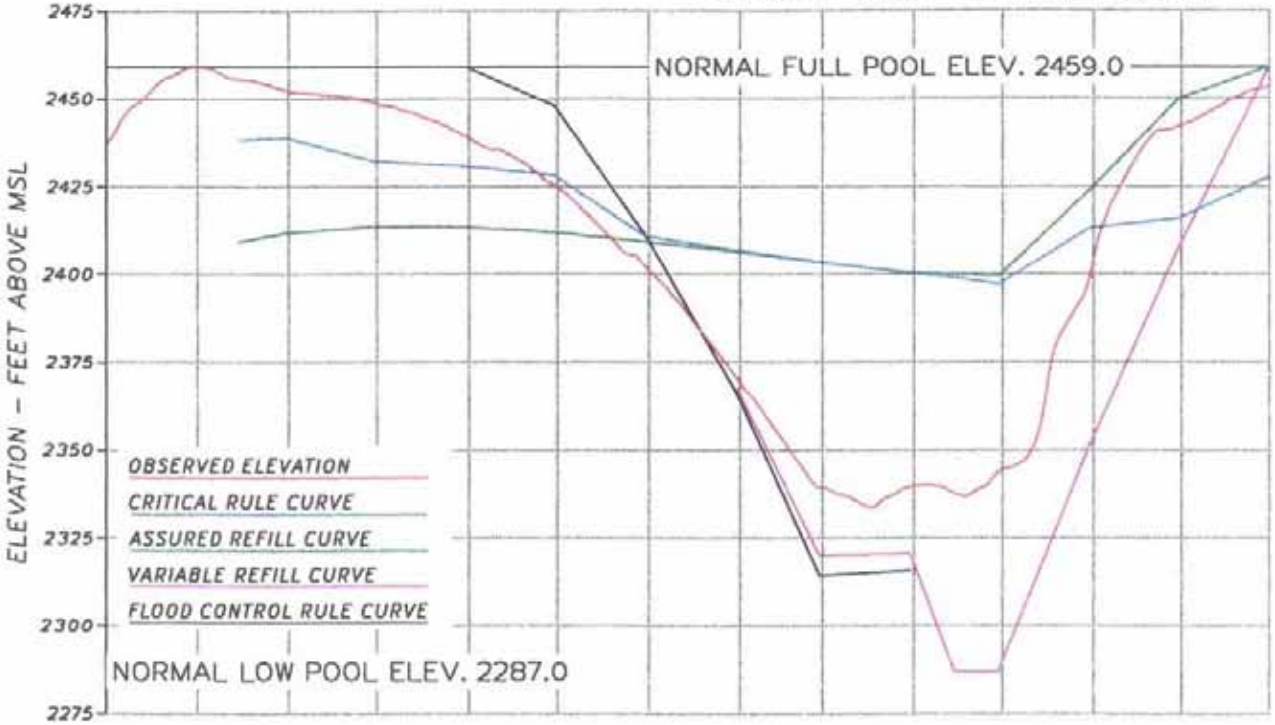


CHART 9
REGULATION OF LIBBY
1 JULY 1996 – 31 JULY 1997



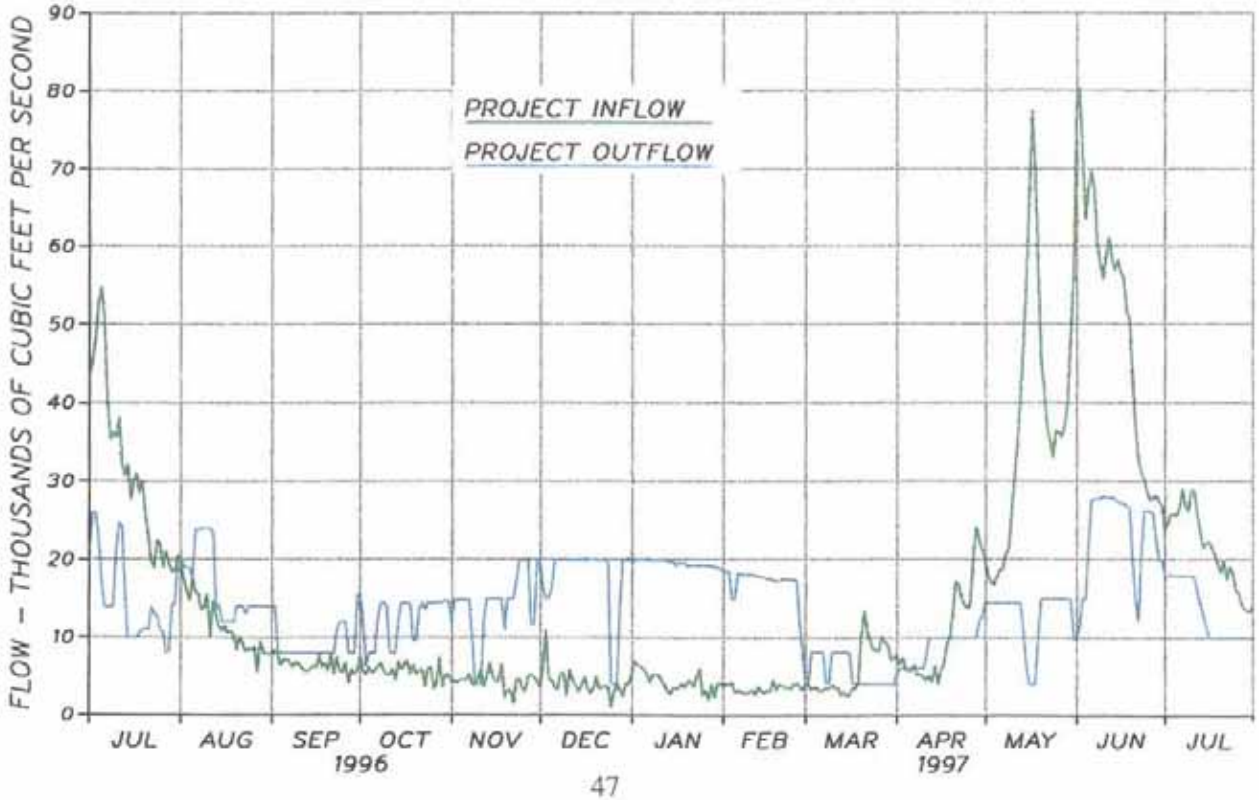
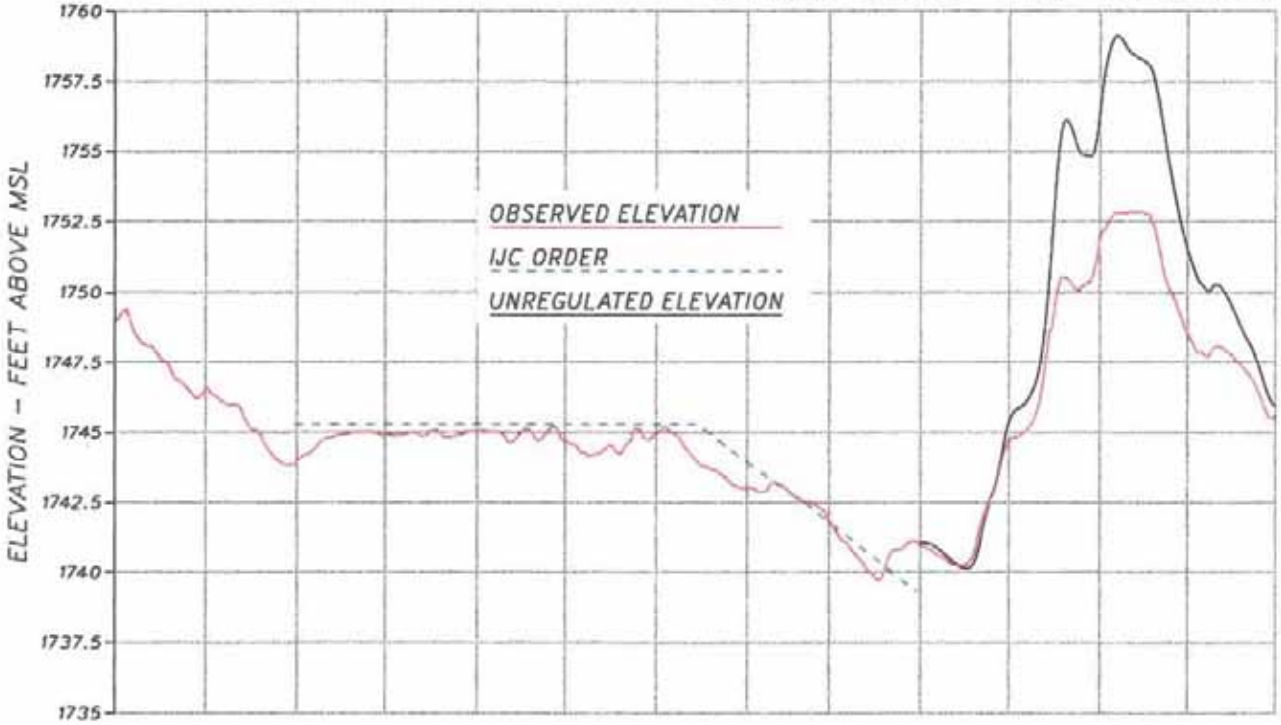


CHART 10
REGULATION OF KOOTENAY LAKE
1 JULY 1996 – 31 JULY 1997



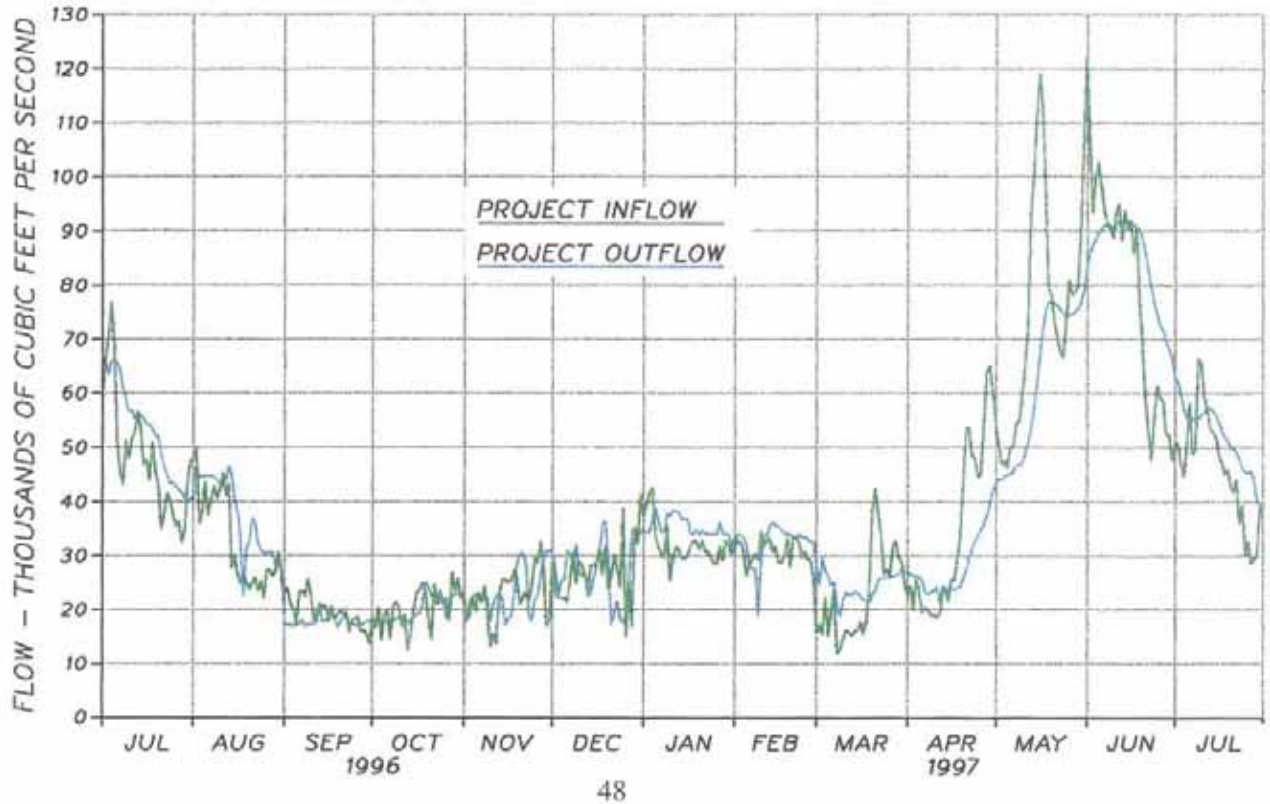


CHART 11
COLUMBIA RIVER AT BIRCHBANK
1 JULY 1996 - 31 JULY 1997

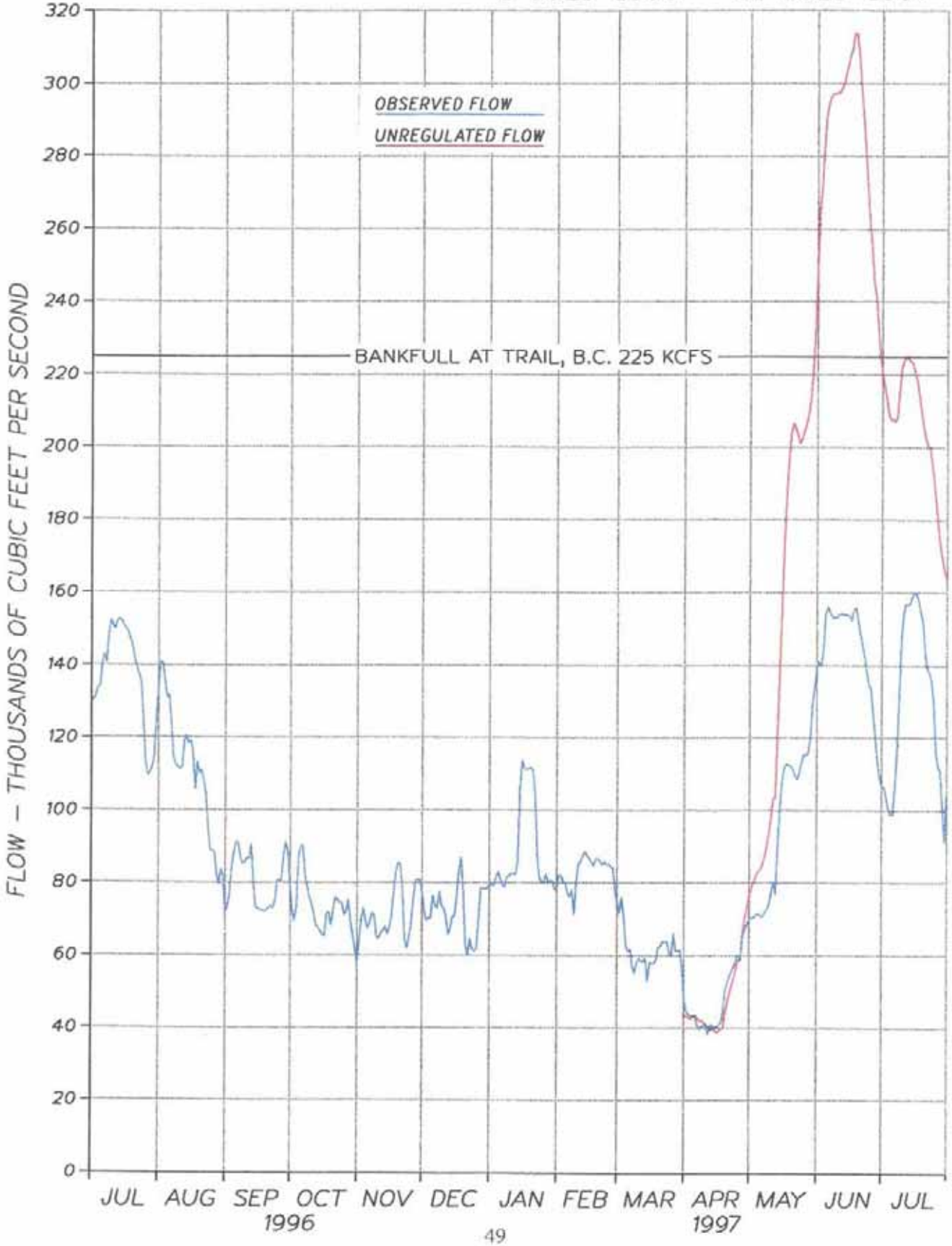
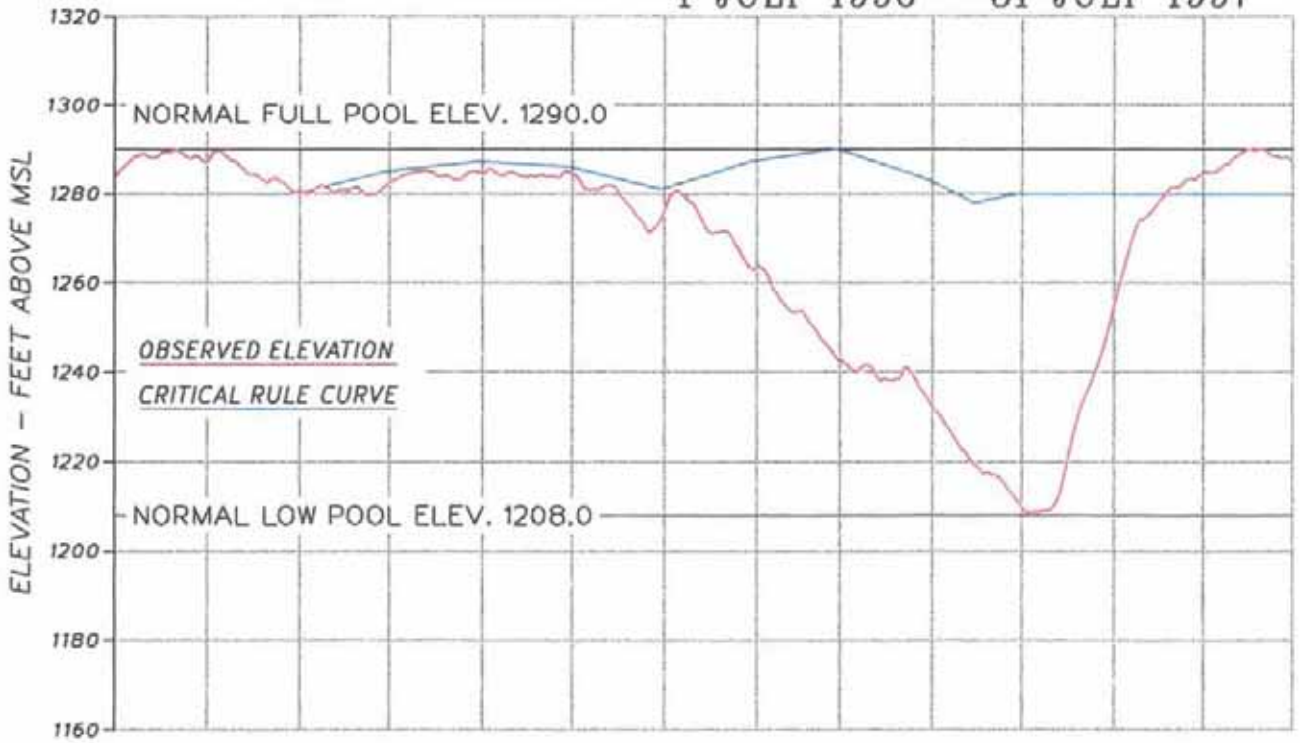


CHART 12
REGULATION OF GRAND COULEE
1 JULY 1996 – 31 JULY 1997



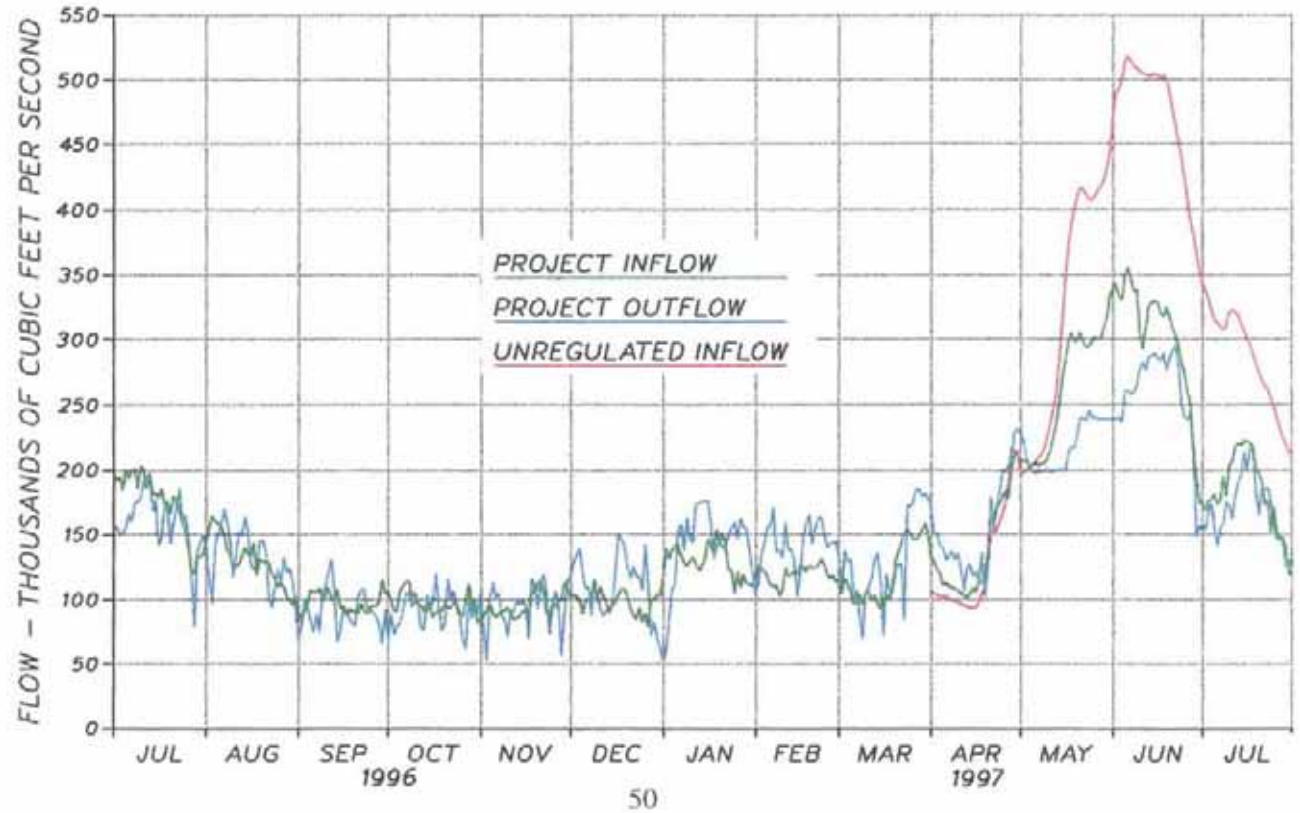


Chart 13
Columbia River at The Dalles
1 July 1996 - 31 July 1997

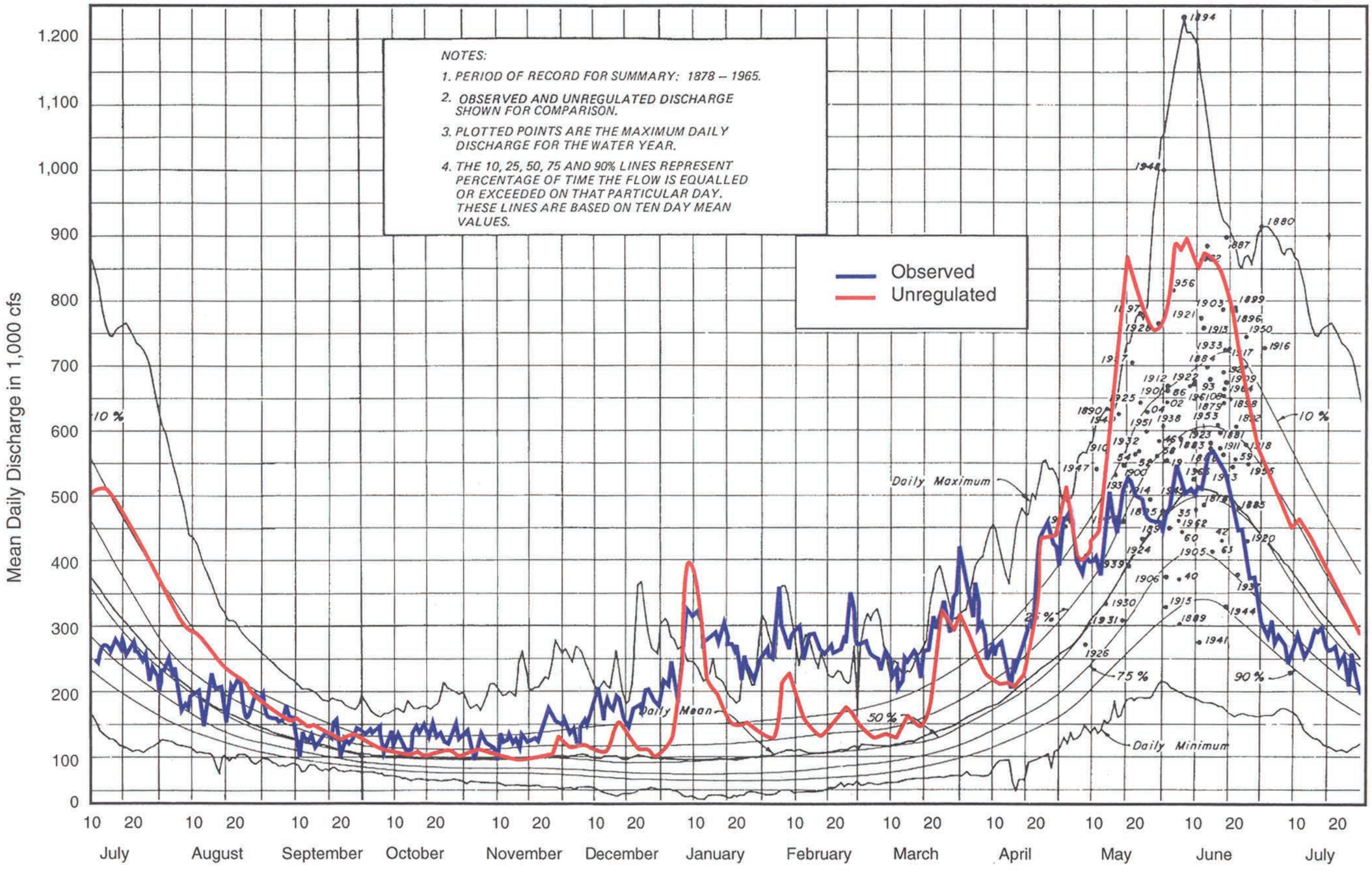


CHART 14
COLUMBIA RIVER AT THE DALLES
1 APRIL 1997 – 31 JULY 1997

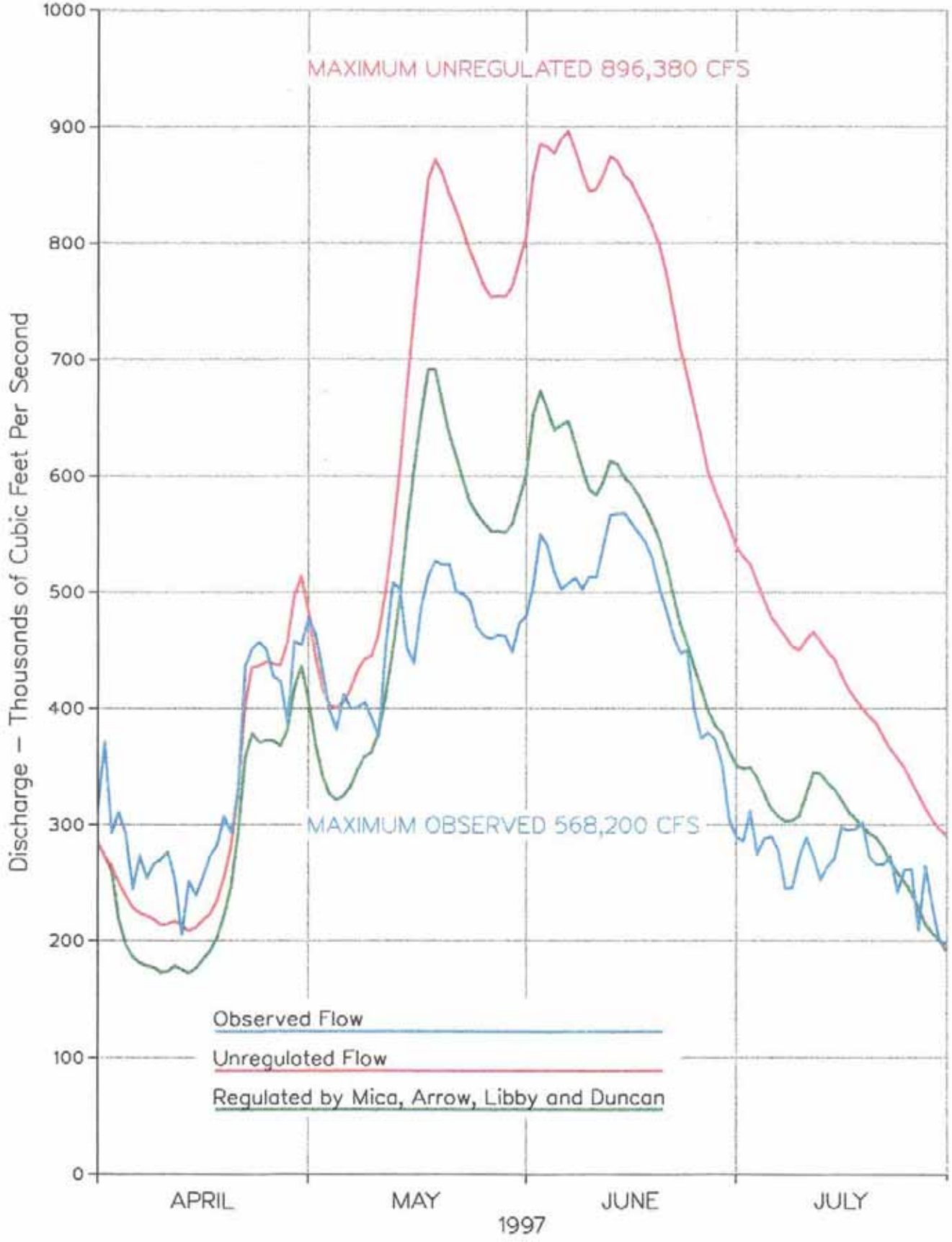


CHART 15
1997 RELATIVE FILLING
ARROW AND GRAND COULEE